10. SEWAGE SLUDGE (BIOSOLIDS)

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L. Approved Methods for the Analysis of Sewage Sludge (40 *CFR* Part 503)

Related Websites

Office of Wastewater Management (OWM) Homepage: http://www.epa.gov/owm
Office of Science and Technology (OST) Homepage: http://www.epa.gov/ost

10. A. Review of the Sewage Sludge Regulations (Biosolids)

In addition to materials in this chapter, inspectors must be familiar with Chapter 1 - "Introduction" & Chapter 2 - "Inspection Procedures".

Section 405 of the Clean Water Act (CWA) mandated the development of a Federal sludge management program. On February 19, 1993, Environmental Protection Agency (EPA) promulgated technical standards for the use or disposal of sewage sludge [see 40 *Code of Federal Regulations (CFR)* Part 503, 58 *Federal Regulation (FR)* 9248]. These regulations contain technical standards for three sewage sludge use or disposal practices: land application, surface disposal, and incineration. The National Pollutant Discharge Elimination System (NPDES) regulations had previously been revised in preparation for the issuance of the final technical standards. As NPDES permits are reissued, they include sludge use or disposal requirements. However, the Federal 503 sludge regulations are the minimum requirements that apply to and are enforceable against a facility engaged in a regulated sludge use or disposal practice, regardless of whether that facility's NPDES permit contains sludge use or disposal conditions. Thus, the NPDES permit is not a shield in the case of noncompliance with sludge requirements. This means that as of February 19, 1994, inspectors are expected to identify at a minimum violations of Part 503 requirements. Then if appropriate the enforcement authority can issue a notice of violation or take other appropriate enforcement actions.

The Federal and State sludge management programs currently regulates the use and disposal of sewage sludge, which is the residual generated from the treatment of domestic sewage in a treatment works. Facilities, such as Publicly Owned Treatment Works (POTWs), which are subject to NPDES permit conditions for aqueous discharges to surface waters are now, as generators and preparers of sewage sludge, subject to the 503 regulations. In addition, the sludge program includes other facilities that have not been a part of the NPDES program because they were not point sources of discharge to waters of the United States. Examples of facilities that are now regulated and that may eventually receive permits for the use and disposal of sewage sludge include sewage sludge incinerators, composting facilities, and sewage sludge surface disposal sites. Note, the Part 503 regulation also includes simplified requirements for the land application of domestic septage.

Although the regulations refer to the residual generated from the treatment of domestic sewage as sludge, the term “biosolids” is the current term in general use for those sewage sludges which have been treated and conditioned through biological, chemical, and/or physical processes for the purpose of beneficial reuse as a soil amendment for growing plants and trees.

While EPA was in the process of finalizing more comprehensive regulations to address the use or disposal of sewage sludge, there were existing Federal regulations that applied to the land application and landfilling of sludge. These regulations, issued as interim final criteria in 40 *CFR* Part 257, were promulgated jointly under the authority of the CWA and the Resource Conservation and Recovery Act (RCRA) in 1979. Regulations relating to sewage sludge land disposal practices are promulgated in 40 *CFR* Part 258 for disposal of sewage sludge in Municipal Solid Waste Landfills (MSWLFs) and 40 *CFR* Part 503 for sewage sludge use or

disposal by land application, surface disposal, or incineration replaced them. The application of industrial sludge to the land continues to be regulated by 40 *CFR* Part 257. In addition, the Clean Air Act (CAA) regulations under 40 *CFR* Parts 60 and 61 continue to apply to the operations and air emissions of sewage sludge incinerators. The relevant requirements in 40 *CFR* Part 258 and 40 CFR Parts 60 and 61 are described below.

> 40 *CFR* Part 258—On October 9, 1991, EPA promulgated regulations under Part 258 that established criteria for MSWLFs and standards for the co-disposal of sewage sludge with municipal solid waste. Part 503 requires that sewage sludge be sent to a MSWLF to comply with the appropriate Part 258 requirements. Because the material that is disposed of in MSWLFs is very diverse (e.g., household garbage, commercial solid waste and sewage sludge), the approach to regulating solid waste is different. Instead of regulating pollutants in the solid waste, Part 258 imposes design, operation, and maintenance requirements on the final disposal site. Although pollutant limits are not imposed, sludge to be disposed of must be nonhazardous, as demonstrated by using the Toxicity Characteristic Leaching Procedure (TCLP) and pass a paint filter test to demonstrate the sludge has no free liquids.
>
> 40 *CFR* Part 60, Subpart O —Emission standards for particulates and opacity and operational standards are specified for new source sewage sludge incinerators. New source incinerators are those constructed after June 11, 1973. If mixed municipal waste is being incinerated, then Subpart Ea—Standards of Performance for Municipal Waste Combustors—apply.
>
> 40 *CFR* Part 61, Subparts C & E —Standards were promulgated under authority of the CAA that limit the emission of beryllium and mercury from sewage sludge incinerators. The Part 503 sludge regulations require compliance with the Part 61 beryllium and mercury emission standards.

In general, the Part 503 regulations apply the following types of requirements to the three sewage sludge use or disposal practices:

- Pollutant limits [9 pollutants under land application (40 *CFR* 503.13), 3 pollutants under surface disposal (40 *CFR* 503.23), and 7 pollutants under incineration (40 *CFR* 503.43)]
- Pathogen and vector attraction reduction requirements
- Management practices for siting and operation of sludge use or disposal activities
- Minimum monitoring requirements
- Specific recordkeeping and reporting requirements.

A brief explanation of the requirements that apply to each sewage sludge use or disposal practice is provided below.

Land Application Requirements

Pollutant Limits

The regulations establish four types of limits that regulate 9 pollutants. Figure 10-1 illustrates which limits apply, based on the final sludge use; conversely, Figure 10-2 illustrates which requirements apply, based on the level of treatment achieved.

- Ceiling Concentration Limits — Express these limits as milligram of pollutant per kilogram of sludge on a dry weight basis that can be land applied.

- Cumulative Pollutant Loading Rates (CPLRs) — Express these limits as the total amount of pollutant (kilograms) in sludge that does not meet pollutant concentration limits that can be applied to an area (hectare) of land. When this loading rate is reached, no additional sludge can be applied to the site.

- Pollutant Concentration Limits –- Express these limits as the monthly average concentration of pollutant milligram per kilogram of sludge on a dry weight basis. They apply to sewage sludge sold or given away in a bag or other container and as an alternative limit to CPLRs for bulk sewage sludge.

- Annual Pollutant Loading Rates — Express these limits are the amount of pollutant (kilograms) in a bagged product that does not meet the monthly average pollutant concentration limits that can be applied in a 365-day period on an area (hectare) of land. This loading rate limits the amount of sewage sludge product sold or given away in a bag or other container on a dry weight basis that can be applied each year.

All sewage sludge that is land applied under the requirements of the land application portion of Part 503 must meet the (Table 1) Ceiling Concentration Limits. However, appliers of sewage sludge that meets the “High Quality” (Table 3) Pollutant Concentration Limits do not need to track cumulative loadings of pollutants for this material, while appliers of material that does not meet the “High Quality” Table 3 values but does meet the Table 1 values are required to limit pollutant loadings from sewage sludge application to the (Table 2) Cumulative Pollutant Loading Rates (CPLRs).

Sewage sludge products that are sold or given away by the facility or retailer in bags or other containers must meet the “High Quality” (Table 3) Pollutant Concentration Limits, or meet the (Table 1) Ceiling Concentration Limits and be applied at an annual sewage sludge product application rate that is based on the (Table 4) Annual Pollutant Loading Rate.

Management Practices

The five management practices in 40 *CFR* 503.14 are intended to supplement the pollutant limits and provide additional protection to endangered species and their habitats, surface water, wetlands, groundwater, and human exposure to the sludge. Four are applicable to bulk sludge; one is applicable to bagged or containerized sludge.

Operational Standards: Pathogen and Vector Attraction Reduction Requirements

There are two categories of pathogen reduction requirements: Class A [40 *CFR* 503.15, 503.32(a)] and Class B [40 *CFR* 503.15, 503.32(b)] (with associated public access and site use restrictions on the use of Class B sludge).

- Class A requirements [40 *CFR* 503.32(a)] result in pathogens, at or below the detection limits of the methods (at the time of regulatory development) and sewage sludge that may be used without site restrictions or limiting public access.

- Class B requirements [40 *CFR* 503.32(b)] significantly reduce (but do not eliminate) the pathogens in the sludge and require a waiting period before the land on which the sludge was applied may be used for certain activities.

Sludge that is sold or given away by the facility or retailer in a bag or other container must meet Class A requirements. Apply only Class A bulk sludge to lawns or home gardens. Apply only Class A or Class B bulk sewage sludge elsewhere (i.e., agricultural land, forest, or reclamation sites).

Under Part 503, six alternative approaches are available for achieving Class A sludge. Three alternatives (with specific site restrictions for use of the treated sludge) are provided for achieving Class B sludge.

EPA retained substantially the same pathogen reduction requirements in the Part 503 regulation as were used as the basis of the Part 257 requirements. Therefore, among the alternatives to achieve Class B sludge is treatment using one of the Processes to Significantly Reduce Pathogens (PSRP). Similarly, Class A sludge may be achieved by using one of the Processes to Further Reduce Pathogens (PFRP).

Land applied sludge is subject under the Part 503 regulations to vector attraction reduction requirements to reduce the characteristics of the sludge that attract disease vectors (i.e., insects that are capable of transporting infectious agents, ultimately to humans). Part 503 requires compliance with one of eight vector attraction reduction treatment alternatives if the sludge will be sold or given away in a bag or other container [40 *CFR* 503.33(a)(3)]. Bulk sewage sludge applied to lawns or home gardens must also meet one of eight vector attraction reduction treatment alternatives [40 *CFR* 503.33(a)2)]. Bulk sewage sludge applied elsewhere must meet one of 10 treatment alternatives [40 *CFR* 503.33(a)1)].

Monitoring, Recordkeeping, and Reporting Requirements

As with other NPDES provisions, while the permitting authority may reduce monitoring frequencies based upon consistent demonstrated performance for at least 2 years, Part 503 requires a minimum monitoring frequency (e.g., once per year). (For example, a case might be made for the minimum monthly or quarterly monitoring requirements for a particular parameter by a larger facility to be reduced based upon consistent performance, but not below a minimum of once per year.)

Part 503 recordkeeping requirements differ depending on the type of pollutant limits applied. Recordkeeping requirements, including certification statements specified in Part 503, are imposed on generators/preparers, while other specific recordkeeping requirements are imposed on appliers. The regulations require the facility to retain the specific information for 5 years,

except that some information on applicable cumulative pollutant loading rates must be retained by the facility indefinitely.

While all facilities must maintain records, only a subset must report under the Part 503 regulations. Those facilities that must report at least once per year are listed below.

- Class I sludge management facilities
- POTWs with a design capacity equal to or greater than 1 Million Gallons per Day (MGD)
- POTWs serving a population of 10,000 or more.

Surface Disposal Requirements

Surface Disposal includes monofills (sewage sludge-only landfills), dedicated disposal surface application sites, (e.g., where sewage sludge pollutants may be applied under controlled conditions at higher than the agronomic rate for disposal purposes even though there may also be beneficial use aspects), as well as piles or mounds, and impoundments or lagoons where the sewage sludge remains on the land beyond 2 years unless it can be affirmatively documented that such operations are “treatment” or “temporary storage” rather than permanent disposal sites.

Pollutant Limits

The 40 *CFR* 503.23 regulates three pollutants. Limits apply to sewage sludge that is placed on or in a surface disposal site that does not have a liner and leachate collection system. There are no pollutant limits on sewage sludge placed in sewage sludge units equipped with a liner and leachate collection system. The distance between the active sewage sludge unit and the site property line/boundary determine the specific pollutant limits that apply; the closer the distance to the boundary, the more stringent the limits (see Figure 10-3). An owner/operator can request site-specific pollutant limits; the permitting authority established these limits through a permit.

Management Practices

The 40 *CFR* 503.24 established a total of 14 management practice requirements. Many are one-time surface disposal site location restrictions. Others address operational activities (e.g., leachate and runoff collection systems, methane gas monitoring) and post-closure activities.

Operational Standards

Under the Surface Disposal requirements (40 *CFR* 503.25), sewage sludge must meet one of the Class A or Class B pathogen reduction alternatives unless the sewage sludge is covered with soil or other material daily. The inspector should note, however, that the Class B site restrictions only apply to land applied sewage sludge. Surface disposed sludge must also meet one of eleven vector attraction reduction alternatives.

Monitoring, Recordkeeping, and Reporting Requirements

Regulations require monitoring and recordkeeping requirements (40 *CFR* 503.26 to 503.28), including certification statements, for the sludge generator or final preparer and/or the owner/ operator of the surface disposal site. Regulation require minimum monitoring frequencies based on the volume of sludge disposed. The facility must maintain all records for 5 years. The same classes of facilities identified under the land application section must report at least once per year.

Incineration Requirements

Pollutant Limits

The regulations cover a total of seven pollutants in sewage sludge that is incinerated. Limits for five metals are calculated by the permitting authority based on site-specific factors using the equations specified in 40 *CFR* 503.43. Limits for the other two pollutants (mercury and beryllium) are derived from air emission standards promulgated under 40 *CFR* Part 61. These limits appear in the permit issued to the owner/operator of the sewage sludge incinerator.

Operational Standards

The 40 *CFR* 503 establishes an average monthly standard on the total hydrocarbons or carbon monoxide concentration in the exit gases of an incinerator to protect from excessive emissions of organic pollutants.

Management Practices

The seven management practices in 40 *CFR* 503.45 ensure that certain instruments are correctly installed, calibrated, operated, and maintained; that incinerator maximum combustion temperature and air pollution control equipment operating standards are established; and that endangered species and their habitats are protected. The specific management practice requirements should be established by the permitting authority based on site-specific factors and should appear in the incinerator's permit.

Monitoring, Recordkeeping and Reporting Requirements

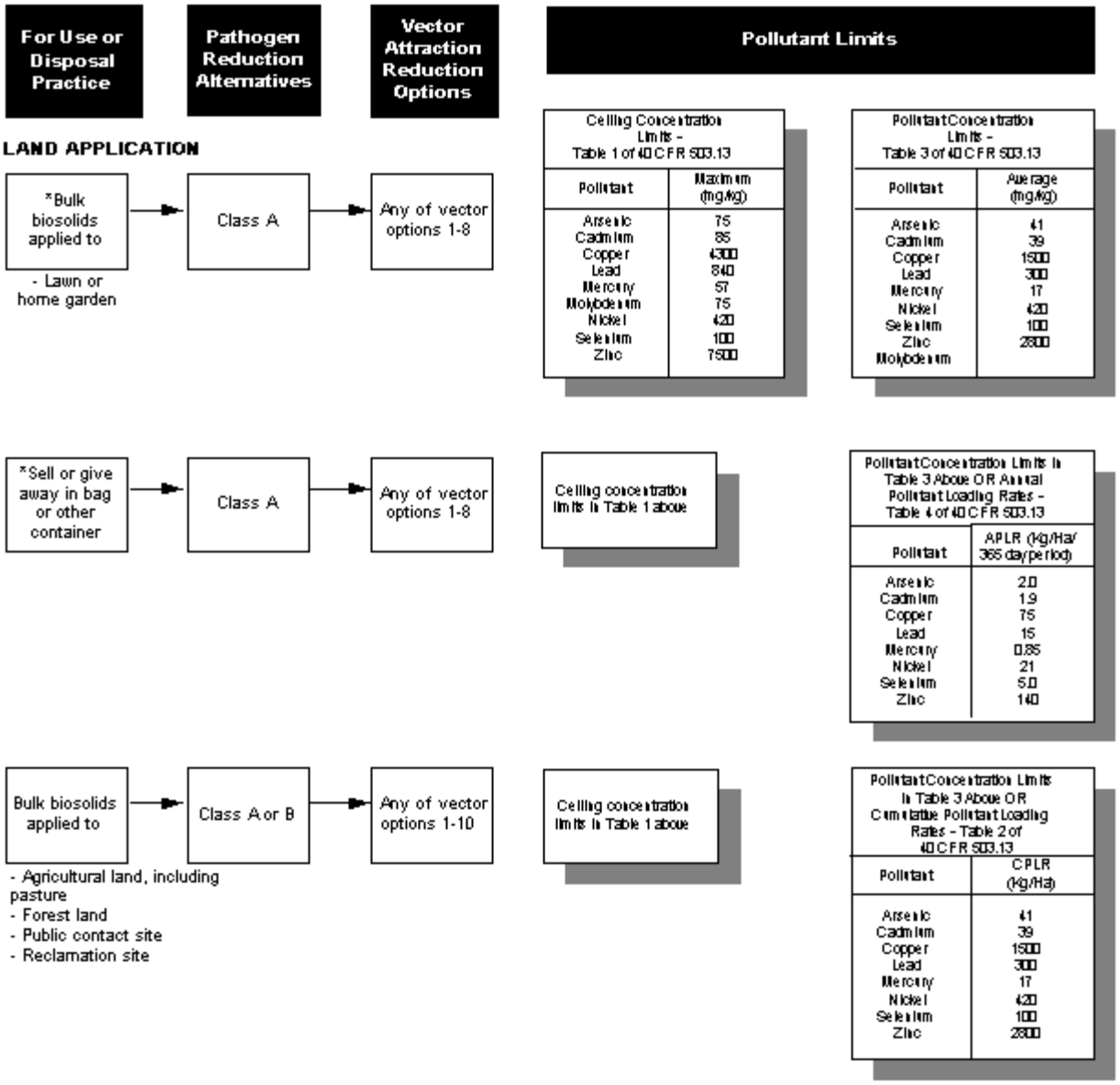
The 40 *CFR* 503.47 and 503.48(a), imposes monitoring requirements for sewage sludge to be incinerated on the owner/operator of the incinerator. The 40 *CFR* 503.46 to 503.48 requires monitoring (a) of sewage sludge for pollutant (i.e., seven metals) concentrations; (b) of incinerator stack exit gases for total hydrocarbon or, alternatively, carbon monoxide (CO), oxygen concentrations, and moisture content; and (c) of incinerator combustion temperatures and air pollution control equipment operating parameters. Monitoring requirements to demonstrate compliance with Part 61 beryllium and mercury standards are also likely to be imposed on owners/operators of sewage sludge incinerators (40 *CFR* 503.47(d)(e).

Records required to be maintained by owners/operators of incinerators are specified both in 40 *CFR* 503.47 and site-specific conditions in the NPDES or sludge permit.

As specified in 40 *CFR* 503.48, the same classes of facilities identified under the land application section are required to report at least once per year. Reporting requirements are imposed on owners and operators of sewage sludge incinerators.

Figure 10-1

Sludge Quality Requirements for Land Application Uses



*Exceptional Quality (EQ) material. General requirements, management practices, site controls, and harvesting restrictions do not apply.

Figure 10-2

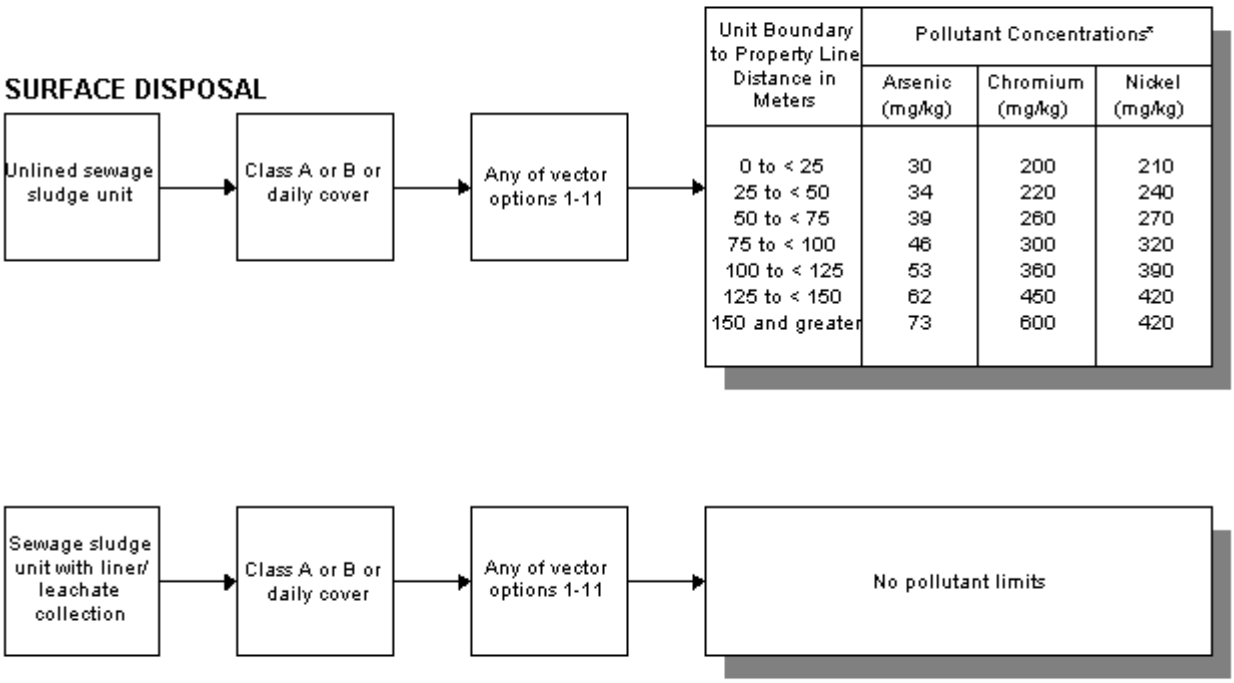
Land Applied Sludge
Requirements Based on Level of Treatment Achieved

SLUDGE TYPE	RESULTING REQUIREMENTS
Exceptional Quality (EQ)	
1) Meets all pollutant concentration limits (Table 2-1, p. 29) 2) Meets any of the Class A alternatives (Table 2-5, p. 37) 3) Meets any of V.A.R. Options 1-8 (Table 2-6, p. 37)	Unregulated for Use Monitoring, Recordkeeping, and Reporting Requirements
Pollutant Concentration (PC)	
1) Meets all pollutant concentration limits (Table 2-1, p. 29) 2) Meets any of the Class B alternatives (Table 2-5, p. 37) 3) Meets any of V.A.R. Options 1-10 (Table 2-6, p. 37)	Site Restrictions (Fig. 2-4, p. 38) Management Practices (Fig. 2-9, p. 45) General Requirements (Fig. 2-8, p. 44) Monitoring, Recordkeeping, and Reporting Requirements
OR	
1) Meets all pollutant concentration limits (Table 2-1, p. 29) 2) Meets any of the Class A alternatives (Table 2-5, p. 37) 3) Meets V.A.R. Option 9 or 10 (Table 2-6, p. 37)	Management Practices (Fig. 2-9, p. 45) General Requirements (Fig. 2-8, p. 44) Monitoring, Recordkeeping, and Reporting Requirements
Cumulative Pollutant Loading Rate (CPLR)	
1) Meets ceiling concentration limits (Table 2-1, p. 29) 2) Meets any Class A or Class B alternative (Table 2-5, p. 37) 3) Meets any of V.A.R. Options 1-10 (Table 2-6, p. 37)	Site Restrictions (Fig. 2-4, p. 38) Management Practices (Fig. 2-9, p. 45) General Requirements (Fig. 2-8, p. 44) Monitoring, Recordkeeping, and Reporting Requirements CPLR Loading Rate Limits (Table 2-1, p. 29)
Annual Pollutant Loading Rate (APLR) **(For solids sold or given away)**	
1) Meets ceiling concentration limits (Table 2-1, p. 29) 2) Meets any of the Class A alternatives (Table 2-5, p. 37) 3) Meets any of V.A.R. Options 1-8 (Table 2-6, p. 37)	Site Restrictions (Fig. 2-4, p. 38) Management Practices (Fig. 2-9, p. 45) General Requirements (Fig. 2-8, p. 44) Monitoring, Recordkeeping, and Reporting Requirements APLR Loading Rate Limits (Table 2-1, p. 29)

NOTE: Tables and page numbers referenced above are from EPA's
A Plain English Guide to the EPA Part 503 Biosolids Rule , September 1994.

Figure 10-3

Sludge Quality Requirements for Surface Disposal



** Site-specific limits may be approved by the permitting authority, if requested.*

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10. B. Sludge (Biosolids) Inspection Procedures

Scope of Inspection Activities

Inspectors should verify compliance with the following general activities:

- Sludge monitoring, recordkeeping, and reporting
- Sludge treatment operations
- Sludge sampling and laboratory Quality Assurance (QA).

EPA intends for the evaluation of sludge management activities to be incorporated into the existing inspection structure so that inspection resources can be used most efficiently. The inspector can identify and investigate problems that might contribute to noncompliance with sludge requirements during any inspection site visit. The Pretreatment Compliance Inspection (PCI), the Compliance Evaluation Inspection (CEI), and the Performance Audit Inspection (PAI) are the most likely vehicles for evaluating compliance with sludge requirements. Examples of how the NPDES inspector may use existing NPDES inspections when evaluating sludge requirements are presented below.

- CSI—The Compliance Sampling Inspection (CSI) is used if the inspector decides that sludge sampling is necessary to determine compliance with applicable requirements.

- CEI—The inspector has historically looked at sludge treatment as part of the Compliance Evaluation Inspection (CEI) because of its effect on wastewater treatment. This evaluation of sludge treatment should be expanded to include a review of sludge monitoring, reporting, and record-keeping, and a more comprehensive evaluation of the Operation and Maintenance (O&M) of sludge treatment processes, to evaluate compliance with sludge permit requirements.

- PAI—The Performance Audit Inspection (PAI) may evaluate compliance with sludge monitoring requirements, and evaluate the permittee's sludge sampling and analytical procedures.

While NPDES inspectors are not required to conduct an in-depth compliance assessment of sludge final use and disposal practices when such practices occur away from the treatment plant, it can help ascertain the vector reduction compliance status at these sites rather than at the Wastewater Treatment Plant (WWTP). In situations where final use and disposal requirements have been established in the facility's NPDES permit (e.g., management practices such as 10-meter buffer zones between the sludge application site and surface waters) and the activity is offsite, the inspector should verify compliance with those requirements through a records review at the facility. As part of a sampling inspection, the inspector may need to sample the sludge to determine compliance with pollutant limits.

EPA intends to focus sludge inspection activities on those aspects of sludge management that the inspector can easily evaluate during an existing NPDES compliance or pretreatment inspection. Inspectors will rely on an evaluation of sludge treatment operations, the observation

of onsite sludge storage and disposal activities, and the review of sludge monitoring and disposal records to identify actual and potential noncompliance with sludge requirements. Inspectors should document compliance or noncompliance with sludge final use or disposal requirements in accordance with standard NPDES compliance inspection procedures. An inspection checklist is useful for documenting that all necessary information has been collected. Inspection checklists are included at the end of this chapter. These checklists are based on the checklists in EPA's *Guidance for NPDES Compliance Inspector: Evaluation of Sludge Treatment Processes* (EPA November 1991) and *Guidance for NPDES Compliance Inspector: Verifying Compliance with Sludge Requirements* (EPA November 1991), as modified by EPA Region 8. The checklists should be used in conjunction with the checklist questions found in the 1991 guidance manuals. However, sludge permits may contain additional sludge permit conditions, based on case-by-case considerations, that are not included on the checklist. The inspector should identify additional permit requirements and verify compliance with these conditions as well. To accomplish this, it is recommended that the inspector expand the checklist, if necessary, to ensure that it is specific to the NPDES permit and the sludge final use or disposal activity. The inspector should complete the checklist and should incorporate his/her findings and conclusions in the final inspection report prepared for the facility.

The NPDES compliance inspector should consult EPA's 1991 *Guidance for NPDES Compliance Inspector: Evaluation of Sludge Treatment Processes* when preparing to conduct a sludge inspection. This technical reference presents a detailed examination of sludge unit processes and also contains extensive technical checklists that summarize the most critical elements of sludge thickening, stabilization, conditioning, dewatering, and disinfection. A technical understanding of the proper design and operation of the sludge treatment processes is essential for conducting thorough and informed sludge inspections.

Inspection Preparation

On preparing for the inspection, the inspector should:

- Review the NPDES Permit (or the facility's sludge permit, if applicable). When reviewing the NPDES permit file in preparation for the inspection, identify:
  - Permit conditions applicable to sludge including treatment; general requirements; management practices; and monitoring, reporting, and recordkeeping requirements
  - Any additional requirements in the NPDES permit that may reflect State regulations. Additionally, the NPDES permit may incorporate a separate State permit by reference, in which case the State permit is also enforceable under the Federal CWA.
- Review sludge self-monitoring data
- Become familiar with the sludge disposal practices used
- Review appropriate Federal regulations (i.e., 40 *CFR* Part 503 Regulations, or Part 258 if sludge is disposed of in a municipal solid waste landfill, and any other applicable State or local regulations)

- Review relevant guidance for background information and implementation procedures (e.g., guidelines on calculating agronomic rate, EPA's Process Design Manuals for Land Application of Municipal Sewage Sludge and Municipal Sludge Landfills, Control of Pathogens and Vector Attraction in Sewage Sludge)

- Verify that records kept by the permittee help in evaluation of compliance with sludge requirements.

Records Review

The Part 503 sludge regulations contain recordkeeping and reporting requirements. The facility's NPDES or sludge permit may have additional recordkeeping or reporting requirements. The inspector should conduct an evaluation of the sludge records and reports found at the facility to determine compliance with these recordkeeping and reporting requirements. The inspector should use the procedures listed below for these routine inspections. If suspected violations are uncovered during the routine evaluation, a more intensive investigation should be conducted.

The inspector should check in the records review process, the evaluation of compliance with sludge recordkeeping requirements on the following:

- Does the facility have all required information available for review?

- Does the facility address all regulated pollutants and sludge use and disposal practices?

- Does the facility have all the current sludge information?

- Does the facility maintain sludge records for at least 5 years (commencing July 20, 1993)?

- Does the facility's information contained in the sludge records support the data submitted to the permitting authority?

- Does the facility's records indicate areas needing further investigation?

The inspector should also identify whether violations of sludge-related permit requirements (e.g., concentration limits and/or management practices) have been reported to the control authority, as required by the permit. Finally, the inspector should verify that the permittee has notified EPA of any changes to sludge use or disposal practices.

Evaluation Procedures

The inspector should first review the permit and fact sheet and list all sludge recordkeeping requirements. Table 10-1 is a list of records that may be relevant for sludge. This list is supplemented by Table 10-2, which describes records relevant to the operation of specific sludge treatment unit processes. Throughout the inspection, compare the facility's operations with the permit conditions to verify that required permit activities for sludge are correct, current, and complete.

An evaluation of sludge self-monitoring records and/or procedures involves the same elements as an evaluation of their wastewater monitoring data; however, there are some special considerations inherent in sludge sampling. In evaluating the permittee's records, inspectors should look for documentation regarding:

- Regulated Pollutants—As identified in the NPDES permit or applicable Federal or State regulations.

- Monitoring Frequency—As identified in the NPDES permit or applicable Federal or State regulations. The inspector should note that Part 503 establishes minimum monitoring frequencies based on the quantity of sewage sludge used or disposed of.

- Sample Location—The appropriate sampling point is the last treatment process the sludge goes through before leaving the treatment plant for use or disposal. For example, if digested sludge is land applied, the sludge should be sampled as it is transferred from the digester to the truck prior to being hauled offsite. Table 10-3 identifies sludge sampling points appropriate for the various types of treated sludge.

- Sample Types—Grabs or composites may be appropriate depending on the situation, but it is important to note that a grab sample from a lagoon, drying bed, compost pile, or truck must consist of numerous samples collected from various places in the lagoon, bed, pile, or truck and must be combined to make a representative sample.

- Sample Volume—If evaluating the sample collection process or taking samples, the inspector must ensure that the container is not filled completely. Some space should be left to allow for expansion of the sample due to gas production. Rapid cooling of the sample will also reduce gas production. (Refer to Appendix L for specific sample volumes.)

- Sample Containers—Sample containers are generally the same types as those used for collection of wastewater samples, except that sludge sampling containers should be wide mouth bottles. (Refer to Appendix L for a description of the appropriate container material.)

- EPA Sample Identification Methods—Same as for wastewater sampling.

- Preservation and Holding Times—The primary difference in sludge preservation is that samples should not be chemically preserved in the field because the sludge matrix makes it difficult to thoroughly mix the preservative into the sample. However, samples should be iced. (Refer to Appendix L.)

- Chain-of-custody—Same as for wastewater sampling.

- Quality Control—Same as for wastewater sampling.

- Analytical procedures used by lab—The analytical methods used for sludge are different from those used for wastewater. Approved analytical methods are listed in Part 503 (40 *CFR* 503.8). For example, Part 503 requires that analyses for inorganic pollutants use the procedures in *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, EPA publication SW-846. The inspector should note the information recorded regarding sample handling and analysis at the laboratory and verify that it is correct. If

evaluating the laboratory, the procedures are the same as those followed in a PAI. The inspector should look at:

- Analytical procedures
- Laboratory services
- Instruments and equipment
  - Calibration
  - Maintenance
- Supplies
- Quality Assurance/Quality Control (QA/QC)
  - Precision and accuracy of measurement process
  - Data handling and reporting
  - Records retention
  - Personnel qualifications.

- Analytical Results—Verify that results documented in the files are consistent with those reported.

The inspector should verify that reporting requirements are fulfilled according to the permit and applicable regulations. The NPDES permit may or may not have specific reporting requirements; however, the Part 503 sludge standards have specific reporting requirements that apply regardless of whether they appear in the NPDES permit. The May 1989 revisions to the NPDES regulations established required permit conditions regarding notification of change and at least annual reporting of sludge monitoring results. As NPDES permits are reissued, they will contain, at a minimum, these standard conditions as well as conditions specified in Part 503. Based on the applicable requirements, the inspector should verify that:

- Reports contain all required information
- Reports are submitted at the required frequency
- Data are reported in Discharge Monitoring Report (DMR) or other approved form.

Inspectors should review unit operation records to verify compliance with pathogen and vector attraction reduction requirements. Tables 10-4, 10-5, and 10-6 list the records and operating requirements for the Part 503 Class A pathogen reduction alternatives, the Class B pathogen reduction alternatives, and the vector attraction reduction options, respectively. Inspectors are not expected to review each monitoring record, but rather to verify that records are being maintained and are available for review. If a permittee has problems meeting either its pathogen or vector attraction reduction requirements (e.g., fecal coliform or percent volatile solids reduction), the inspector should review treatment operating records to identify potential noncompliance with the particular operating requirements specified in Part 503 for the particular pathogen and vector reduction process employed by the permittee. For example, an inspector might check a treatment facility's pH or temperature records to determine whether the sludge has been maintained at the appropriate pH or temperature for the required duration during treatment.

The inspector should verify that records are available for all disposal practices:

- Volume of sludge disposed of
- Sludge quality data
- Specific records appropriate for demonstrating compliance with the general requirements, management practices, and operational standards.

The inspector should verify whether records are maintained in accordance with permit requirements. The May 1989 NPDES regulatory revisions created a mandatory permit condition requiring that sludge records be kept for 5 years. The Part 503 regulations establish specific recordkeeping requirements for each party involved in the sewage sludge use or disposal process.

Facility Site Review

Inspection of Solids Handling Unit Processes

Sludge processing arguably poses the greatest challenges in wastewater treatment from the standpoints of design, operation, and maintenance.

When conducting the walk-through visual inspection of the facility, the inspector should be aware of, and look for, physical conditions that are indicative of potential or existing problems. Some of the more common indicators of potential problems are listed in Table 10-7. The presence of these conditions may warrant a more in-depth inspection of the sludge treatment processes. A checklist is provided at the end of this chapter to assist the inspector during the facility site review. The questions on this checklist are sludge-specific and should be asked in conjunction with the Facility Site Review checklist. In addition, many of the questions in the NPDES checklist relate to the overall operation of the facility and therefore, can also be applied to sludge evaluations (e.g., treatment units properly operated and maintained). The inspector should look for conditions that indicate potential or existing problems. If the inspector finds conditions that are a potential problem, this may trigger a more detailed evaluation. EPA has developed guidance and checklists for conducting in-depth evaluations of each of the most common sludge treatment unit processes, *Guidance for NPDES Compliance Inspectors*: *Evaluating Sludge Treatment Processes*, November 1991.

The inspector should determine whether the facility is operating its sludge treatment and disposal processes in a manner consistent with the requirements established in its NPDES permit. If the inspector discovers conditions at the facility that threaten public health or the environment (e.g., contaminating groundwater or surface water, exposing the public to pathogens or disease vectors, or compromising public safety), the inspector should inform the enforcement staff so that appropriate action can be taken. If knowing endangerment is discovered, the criminal investigations unit should be informed.

Many large-scale operations are conducted outside, such as sludge drying, composting, temporary and long-term storage, and loading and hauling. Inspectors should note these outside operations' exposure to rainfall and runoff collection and treatment methods. If storm water collection devices have been constructed, the inspector should evaluate the performance and maintenance of these devices as well as their design capacity (e.g., the 10-year 24-hour storm event or the 25-year 24-hour storm event). Visual observations can detect obvious problems that may contribute to the contamination of surface water or groundwater such as erosion, breaches of dikes or berms, or cracks in the concrete or asphalt. The inspector should inquire as to whether the capacity of the collection devices has ever been exceeded during any storm event.

The sludge loading area should be inspected to determine how the sludge is being hauled or transported. The inspector should note the size of the truckloads and the number of truckloads

hauled over a 1-day period (or another time period). These figures are useful to the inspector in verifying the permittee's records and reports on the volume of sludge generated and disposed of.

Sludge Storage

The inspector should also verify that the permittee has adequate storage capacity for its sludge in the event that its preferred disposal method is interrupted for any reason (e.g., noncompliance with cumulative loading rates on the land application site). There are no Federal requirements specifying a minimal storage capacity; the appropriate capacity will vary depending on the amount of sludge generated and the facility's use or disposal option(s). Storage capacity should address normal, routine storage prior to disposal and should anticipate emergency conditions, such as:

- Equipment malfunction
- Inclement weather
- Unanticipated loss of disposal site
  - Farmer decides to discontinue use of sewage sludge
  - Landfill violates requirements and may no longer accept sludge or is required to close.

Some States have developed storage capacity requirements. If the permittee cannot dispose of its sludge in the preferred manner, it should have either adequate storage capacity for its sludge or clearly established plans for alternative methods of disposal.

Sampling and Laboratory Quality Assurance (QA)

The sludge inspection should evaluate the nature, scope, and adequacy of sludge sampling and analysis conducted by the permittee. The most likely, existing inspection vehicle for conducting this evaluation is the PAI, since it involves a detailed assessment of the permittee's self-monitoring activities, including sample collection and laboratory analysis. The findings of the sampling and laboratory QA review should be summarized and included in the final inspection report for the facility.

Sampling Procedures and Techniques

The inspector's evaluation of the permittee's sludge sampling procedures will address similar criteria as those evaluated in the context of wastewater sampling. The sampling procedure elements that should be evaluated during the inspection include:

- Sample collection techniques
  - Selection of representative sampling sites
  - Sample types
  - Sample volume
  - Sample containers
- EPA sample identification methods
- Sample preservation and holding time
- Chain-of-custody and shipment of samples
- Quality Control (QC)
  - Duplicates
  - Blanks
- Data handling and reporting.

A detailed discussion on evaluating these elements can be found in Chapter Five. While many of these elements are evaluated using the same criteria, regardless of the media being sampled, sludge sample collection techniques and sample preservation are different. The inspector should review EPA's sewage sludge sampling video and refer to EPA's 1989 *POTW Sludge Sampling and Analysis Guidance Manual* for detailed information regarding sludge sampling procedures. Table 10-3 of this document summarizes appropriate sample locations. Appendix L lists sample containers, preservation techniques, and holding times as a quick reference for the inspector. In addition to these references, a few special sludge sampling considerations are described below.

- Equipment. The equipment used to collect sludge samples is different from that used to collect wastewater samples. The automatic composite samplers used to collect wastewater cannot be used to collect sludge samples because the high solids content of the sludge fouls the tubing. The type of equipment used to collect samples of soil or other solid waste material is more appropriate for the collection of sludge samples. Stainless steel buckets, trowels, and augers are typically used to collect solid sludge cake. Graduated glass or plastic pitchers or cylinders, or plastic or stainless steel buckets are used to collect liquid sludge samples.

- Sample Location. If the permit does not identify a specific sludge sampling location, the inspector must select one. (See EPA's sewage sludge sampling video for an overview of this process.) EPA's 1989 *POTW Sludge Sampling and Analysis Guidance Manual* states that for purposes of enforcement, sludge samples must come from the treatment unit process immediately prior to sludge disposal or end use. Often, the last unit process is one of the dewatering processes described in the accompanying technical guidance. Table 10-3, from EPA's 1989 Sampling and Analysis Guidance Manual, suggests appropriate sampling points for a variety of unit processes.

Table 10-1

Records Relevant for Sludge Operations

Sludge Use/Disposal Records

- Volume
- Type of use and/or disposal options used
- Use/disposal sites
- Loading rates of pollutants (e.g., agronomic) at each land application site

Sludge Operating Records

- Daily operating log
- Equipment maintenance scheduled and completed
- Detention time, operating temperature, or pH to evaluate pathogen reduction

Sludge Monitoring Records

- Constituents/pollutants in sludge
- Mass of sludge generated and disposed of (in dry metric tons per year)

Sludge Sampling and Analytical Data

- Dates, times, and locations of sampling
- Sampling protocols and analytical methods
- Results of analyses
- Dates and times of analyses
- Name(s) of analysis and sampling personnel

Sludge Laboratory Records

- Calibration and maintenance of equipment
- Laboratory bench sheets or logs and calculations
- Quality Assurance/Quality Control (QA/QC) records

Table 10-2

Operating Records for Specific Unit Processes

THICKENING PROCESSES

Gravity Thickening	Dissolved Air Flotation	Centrifuge
• Overflow volume/rate • Influent flow • Percent solids - Sludge feed - Thickened sludge - Overflow • Sludge blanket depth	• Sludge feed rate • Recycle flow • Daily operating time • Percent solids - Sludge feed - Thickened sludge - Subnatant • Floating sludge depth • Air flow rate • Retention tank pressure • Percent solids capture • Detention time • Air to solid ratio	• Influent sludge flows • Volume cake produced • Percent solids - Sludge feed - Centrate - Sludge cake • Daily operating time

STABILIZATION PROCESSES (Pathogen and/or Vector Attraction Reduction)

Aerobic Digestion	Anaerobic Digestion	Incineration
• Air supply • Solids retention time • Temperature • DO level • pH • Feed sludge - TS, TVS, and pH - Flow rate • Digested sludge - SOUR - TS, TVS, and pH - Flow rate • Supernatant - Flow rate and BOD - TSS and ph	• Detention time • Temperature • pH and alkalinity • Gas production and quality • Volatile acids • Feed sludge - TS, TVS, and pH - Flow rate • Digested sludge - TS, TVS, and pH - Flow rate • Supernatant - Flow rate and BOD - TSS and pH • Cleaning frequency	• Operating schedule • Sludge feed - Solids content - Feed rate - Volatile solids • Combustion temperature • Sludge residence time • Fuel flow • Off-gas oxygen content • Air feed rate • Emission control equipment - Pressure drop • Type of fuel • Volume of ash produced • Stack gas monitoring
Heat Temperature	**Composting**	**Chemical Conditioning/Stabilization**
• Temperature/time • Pressure • Detention time • Feed sludge - TS and TVS - Flow rate - Percent solids • End product volatile solids	• Oxygen concentration • Temperature and time • Turning frequency • Percent sludge solids • Type and amount of bulking agent(s) • Header pressure	• Chemical types and dosage • Mixing • pH • Temperature
Electron Irradiation	**Gamma Irradiation**	
• Sludge feed rate • Electron dosage • Temperature	• Sludge feed rate • Gamma ray source strength	

Table 10-2

Operating Records for Specific Unit Processes (Continued)

DEWATERING PROCESS		
Vacuum Filter	**Pressure Filter**	**Belt Filter Press**
• Sludge feed - Total solids • Sludge cake - Total solids • Filtrate - Flow - BOD - TSS • Maintenance • Spare parts	• Sludge feed percent solids • Sludge cake percent solids • Volume of sludge processed • Cycle length • Volume conditioning chemicals • Filtrate - Flow - BOD - TSS	• Loading rate • Operating speed • Feed slurry - Total solids and flow • Dewatered sludge - Total solids - Flow • Filtrate and wash water - BOD and SS - TSS and flow • Preventive maintenance • Polymer
Drying Bed	**Drying Lagoons**	**Heat Drying**
• Sludge loading rate • Quantity in bed • Depth of sludge in bed • Date deposited • Detention time • Ambient temperature • Drying bed construction (i.e., lined) • Undertrain destination • Percent solids of the sludge feed and of the dewatered sludge	• Sludge loading rate • Percent solids - Sludge - Decant • Quantity in lagoon • Depth in lagoon • Date deposited • Drying time • Rainfall	• Operating schedule - Start-up - Shut down • Sludge feed rate • Percent solids - Sludge feed - Dried/Pelletized product • Fuel consumption • Air flow • Drying temperature • Detention time • Stack gas monitoring - Oxygen - Particulates - Carbon monoixde - Carbon dioxide
LEGEND: DO = Dissolved Oxygen TS = Total Solids TVS = Total Volatile Solids BOD = Biochemical Oxygen Demand TSS = Total Suspended Solids SS = Suspended Solids SOUR = Specific Oxygen Uptake Rate		

Table 10-3

Sludge Sampling Points

Sludge Type	Sampling Point

Anaerobically digested	Sample from taps on the discharge side of positive displacement pumps.
Aerobically digested	Sample from taps on the discharge lines from pumps. If batch digester is used, sample directly from the digester. Two cautionary notes regarding this practice: • If aerated during sampling, air entrains in the sample. Volatile organic compounds may purge with escaping air. • When aeration is shut off, solids separate rapidly in well-digested sludge.
Thickened	Sample from taps on the discharge side of positive displacement pumps.
Heat treated	Sample from taps on the discharge side of positive displacement pumps after decanting. Be careful when sampling heat treatment sludge because of: • High tendency for solids separation • High temperature of samples (frequently >60°C) can cause problems with certain sample containers due to cooling and subsequent contraction of entrained gases.
Dewatered by belt filter press, plate and frame press, centrifuge, or vacuum filter press	Sample from sludge cake discharge chute and conveyor. Alternatively, sample from collection container or storage bin for the dewatered sludge; sample from many locations within the storage bin and at various depths, collect equal samples from each point, and combine them to form one sample of the total storage bin.
Dewatered or air dried in drying beds, or bin or truck bed	Divide bed into four quadrants, collect equal sample volume from the center of each quadrant, and combine them to form one sample of the total bed. Each grab sample should include the entire depth of the sludge (down to the sand).
Composted	Collect full core samples from randomly selected sites in the pile. Sample directly from front-end loader or other conveyance device as the sludge is being loaded into trucks to be hauled away.

- Sample Collection Techniques. Obtaining a representative sample of sludge is difficult when the sludge is not flowing through a pipe or along a conveyer. To obtain a representative sample of sludge from a sludge bed or lagoon, a compost pile, or a truck, several samples have to be taken from various places in the pile and "combined" to make a representative sample.

- Sample Preservation. Samples of solid sludge are not usually preserved in the field because it is difficult to thoroughly mix the preservative throughout the sludge sample. It is best to preserve sludge samples that are high in solids at the laboratory. The appropriate field preservative outlined in Appendix L is to chill the sample to 4°C. Note, some exemptions do exist such as a sample for the Specific Oxygen Uptake Rate (SOUR) should be kept at the same temperature as the aerobic digestor and analyzed within 30 minutes of sample.

Laboratory Analysis and Quality Assurance

During a PAI, the inspector is already conducting an in-depth evaluation of the permittee's laboratory analytical techniques and QA/QC procedures. The following elements are evaluated during this inspection:

- Permittee sample handling procedures in the laboratory
- Laboratory analysis techniques
  - Permittee laboratory analytical procedures (Analytical methods specified by 40 *CFR* Part 503 or other methods established in the permit)
  - Laboratory services
  - Instruments and equipment
  - Supplies
- QA/QC
  - Precision and accuracy of the measurement process
  - Data handling and reporting
  - Sludge records retention (for 5 years)
  - Personnel qualifications.

Again, many of these elements are evaluated according to the same criteria regardless of the sample being analyzed. The inspector is referred to Chapter Seven and the 1990 *NPDES Compliance Monitoring Inspector Training Module on Laboratory Analysis* for general guidance on inspecting the permittee's laboratory procedures. There are some differences in sample preparation and analytical techniques for sludge with which the inspector should be familiar.

In conducting the sludge component of the PAI, the inspector should closely evaluate the permittee's sample preparation procedures. The sludge matrix is more complex and variable than the wastewater matrix; therefore, the laboratory's development of sample preparation techniques is of particular concern.

The NPDES permit may require the permittee to analyze sludge for conventionals, inorganic pollutants, metals, and pathogens (depending on the ultimate sludge disposal practice). For example, sludge that is going to be land applied will be analyzed for 9 metals and nitrogen to determine the appropriate application rate. Table 10-8 lists the constituents required to be monitored by Part 503. 40 *CFR* 503.8 contains a listing of approved analytical methods and

volatile solids reduction calculations that must be used for monitoring sludge quality. The analytical methods for metals are not the same as those used for the analysis of wastewater.

Appendix L contains the required analytical method, the maximum allowable sample holding times, sample preservation techniques, sample containers, sample preparation methods, and additional comments that may be pertinent to the analytical method.

The inspector should keep the following points in mind when reviewing the permittee's lab and analytical results:

- The Part 503 standards are expressed on a dry weight basis. Laboratory results for sludge are typically reported in one of two forms, wet weight (i.e., mg/L) or dry weight (i.e., mg/kg). Watch out for mg/Kg units that are wet weight rather than dry weight. The laboratory should be providing the results on a dry weight basis. In the event that the laboratory results are reported on a wet weight basis (i.e., in mg/L), the results for each pollutant in each sample must be recalculated to determine the dry weight concentration. To accomplish this conversion, the percent total solids in the sludge sample must be known. Thus, the lab must analyze the sample for percent solids using Method 2540G of *Standard Methods*, 18th Edition.

  The following equation can be used to determine the dry weight concentration because the equation uses the assumption that the specific gravity of water and sewage sludge are both equal to one. However, this assumption holds true only when the solids concentration in the sludge is low. The calculated dry weight concentration may vary slightly from the actual concentration as the solids content increases because the density of the sewage sludge may no longer be equal to that of water. This concern does not arise when the solids content of sludge is usually low. EPA is aware of this potential problem and may make a determination regarding this matter at a later date.

  Determine the pollutant concentration on a dry weight basis using the following abbreviated conversion:[1]

$$\text{PC (dry, mg/kg)} = \frac{\text{PC (wet, mg/L)}}{\text{(\% total solids)}}$$

  where PC = Pollutant concentration

  A unit conversion is incorporated into the equation.

- For metals, a common analytical error is that labs conduct the metals analyses using analytical methods developed for water and wastewater. Analytical methods for water and wastewater are found in *Standard Methods,* while the solid waste analytical methods are found in *Test Methods for Evaluating Solid Wastes* (EPA SW-846). For sludge samples, all metals must be analyzed by SW-846 methods. If you find non-

[1] *Analytical Methods Used in the National Sewage Sludge Survey.* August 1988. U.S. EPA Office of Water Regulations and Standards (WH-552), Industrial Technology Division, Washington, DC.

detects for the metal concentrations, in general the laboratory is not following the method requirement of digesting equivalent to 1gm dry weight of solid.

- Also for metals, note that more than one SW-846 method is provided for each pollutant. The difference between the methods is usually the equipment used [i.e., direct aspiration, furnace, or Inductively Coupled Plasma (ICP) scan] and the level of detection desired. Each of the three methods is EPA-approved, but certain sample characteristics may require one to be used instead of another.
- SW-846 Method 3050 or equivalent, is the required preparation method for all metals except mercury (using equivalent to 1 gram dry weight).

- In contrast to the metals, many of the additional inorganic parameters [e.g., nitrite, Total Kjeldahl Nitrogen (TKN), etc.] require methods that are found in *Standard Methods for the Examination of Water and Wastewater*. There are several reasons for this, one being that there is no method for the parameter that is specific to solid waste.

Table 10-4

Recordkeeping Requirements for Class A Pathogen Reduction Alternatives

Alternative A1—Time and Temperature
• Analytical results for density of *Salmonella sp.* bacteria or fecal coliform (most probable number) • Sludge temperature • Time (days, hours, minutes) temperature maintained
Alternative A2—Alkaline Treatment
• Analytical results for density of *Salmonella sp.* bacteria or fecal coliform (most probable number) • Sludge pH • Time (hours) pH maintained above 12 (at least 72 hours) • Sludge temperature • Percent solids in sludge after drying (at least 50 percent)
Alternative A3—Analysis and Operation
• Analytical results for density of *Salmonella sp.* bacteria or fecal coliform (most probable number) • Analytical results for density of enteric viruses (plaque forming unit/4 grams total solids) prior to pathogen reduction and, when appropriate, after treatment • Analytical results for density of viable helminth ova (number/4 grams total solids) prior to pathogen reduction and, when appropriate, after treatment • Values or ranges of values for operating parameters to indicate consistent pathogen reduction treatment
Alternative A4—Analysis Only
• Analytical results for density of *Salmonella sp.* bacteria or fecal coliform (most probable number) • Analytical results for density of enteric viruses (plaque forming unit/4 grams total solids) • Analytical results for density of viable helminth ova (number /4 grams total solids)

Table 10-4

Recordkeeping Requirements for Class A Pathogen Reduction Alternatives (Continued)

<table>
<tr><th colspan="2">Alternative A5—Processes to Further Reduce Pathogens (PFRP)</th></tr>
<tr><td>• Heat Drying
- Analytical results for density of Salmonella sp. bacteria or fecal coliform (most probable number)
- Moisture content of dried sludge <10 percent
- Logs documenting temperature of sludge particles or wet bulb temperature of exit gas exceeding 80°C

• Thermophilic Aerobic Digestion
- Analytical results for density of Salmonella sp. bacteria or fecal coliform (most probable number)
- Dissolved oxygen concentration in digester >1 mg/L
- Logs documenting temperature maintained at 55-60°C for 10 days

• Heat Treatment
- Analytical results for density of Salmonella sp. bacteria or fecal coliform (most probable number)
- Logs documenting sludge heated to temperatures > 180°C for 30 minutes

• Pasteurization
- Analytical results for density of Salmonella sp. bacteria or fecal coliform (most probable number)
- Temperature maintained at or above 70°C for at least 30 minutes</td><td>• Composting
- Analytical results for density of Salmonella sp. bacteria or fecal coliform (most probable number)
- Description of composting method
- Logs documenting temperature maintained at or above 55°C for 3 days if within vessel or static aerated pile composting method
- Logs documenting temperature maintained at or above 55°C for 15 days if windrow compost method
- Logs documenting compost pile turned at least five times during the 15day period, if windrow compost method

• Gamma Ray Irradiation
- Analytical results for density of Salmonella sp. bacteria or fecal coliform (most probable number)
- Gamma ray isotope used
- Gamma ray dosage at least 1.0 megarad
- Ambient room temperature log

• Beta Ray Irradiation
- Analytical results for density of Salmonella sp. bacteria or fecal coliform (most probable number)
- Beta ray dosage at least 1.0 megarad
- Ambient room temperature log</td></tr>
<tr><th colspan="2">Alternative A6—PFRP Equivalent</th></tr>
<tr><td colspan="2">• Operating parameters or pathogen levels as necessary to demonstrate equivalency to the PFRP
• Analytical results for density of Salmonella sp. bacteria or fecal coliform (most probable number)</td></tr>
</table>

Table 10-5

Recordkeeping Requirements for Class B Pathogen Reduction Alternatives

Alternative B1—Fecal Coliform Count
• Number of samples collected during each monitoring event • Analytical results for density of fecal coliform for each sample collected
Alternative B2—Processes to Significantly Reduce Pathogens (PSRP)
• Aerobic Digestion - Dissolved oxygen concentration - Volatile solids content before and after digestion - Mean residence time of sludge in digester - Logs showing temperature was maintained for sufficient period of time (ranging from 60 days at 15°C to 40 days at 20°C) • Air Drying - Description of drying bed design - Depth of sludge on drying bed - Drying time in days - Daily average ambient temperature • Anaerobic Digestion - Volatile solids content before and after digestion - Mean residence time of sludge in digester - Temperature logs of sludge in digester • Composting - Description of composting method - Daily temperature logs documenting sludge maintained at 40°C for 5 days - Hourly readings showing temperature exceeded 55°C for 4 consecutive hours • Lime Stabilization - pH of sludge immediately and then 2 hours after addition of lime
Alternative B3—PSRP Equivalent
• Operating parameters or pathogen levels as necessary to demonstrate equivalency to PSRP

Table 10-6

Recordkeeping Requirements for Vector Attraction Reduction Sludge Processing Options

Option 1—Volatile Solids (VS) Reduction	**Option 5—Aerobic Processing (Thermophilic Aerobic Digestion/ Composting)**
• Volatile solids concentration of raw and final sludge streams (mg/kg) • Calculations showing 38 percent reduction in volatile solids	• Sludge detention time in digester/composting • Temperature logs showing average temperature above 45°C and minimum temperature above 40°C for 14 consecutive days
Options 2 and 3—Bench-Scale VS Reduction	**Options 6—Alkaline Treatment**
• Description of bench-scale digester • Time (days) that sample was further digested in bench-scale digester (30 days for aerobically and 40 days for anaerobically digested sludge) • Temperature logs showing temperature maintained at 20°C for aerobically or between 30°C and 37°C for anaerobically digested sludge • Volatile solids concentration of sludge (mg/kg) before and after bench-scale digestion	• Logs demonstrating hours pH of sludge/ alkaline mixture was maintained (12 for 2 hours and 11.5 for an additional 22 hours) • Amount of alkaline added to sludge (lbs or gals) • Amount of sludge treated
Option 4—Specific Oxygen Uptake Rate	**Options 7 and 8—Drying**
• Dissolved oxygen readings for sludge sample over 15-minute intervals (mg/L) • Temperature logs showing test was corrected to 20°C • Total solids for sludge sample (g/L) • SOUR calculations (mg/g)	• Results of percent solids (dry weight) test • Presence of unstabilized solids generated during primary treatment

Table 10-7

Sludge Handling Process Evaluation

General Indicators of Problems

- Inadequate sludge removal from clarifiers or thickeners
- Poor dewatering characteristics of thermal treated sludge
- Thickened sludge too thin
- Fouling of overflow weirs on gravity thickeners
- Air flotation skimmer blade binding on beaching plate
- Substantial down-time of sludge treatment units
- Sludge disposal inadequate to keep treatment system in balance
- Mass balance inappropriate (ratio of sludge wasted should be 0.65-0.85 lbs of sludge per lb of BOD removed)
- Sludge decant or return flows high in solids*
- Odors
- Improper loading rates

Anaerobic Digestion Problems

- Inoperative mechanical or gas mixers
- Inoperative sludge heater or low temperature*
- Floating cover of digester tilting
- Inadequate gas production*
- Inoperative gas burner
- Supernatant exuding sour odor from either primary or secondary digester*
- Excessive suspended solids in supernatant
- Supernatant recycle overloading the WWTP
- pH problems*

Aerobic Digestion Problems

- Excessive foaming in tank*
- Objectionable odor in aerobically digested sludge*
- Insufficient dissolved oxygen in digester
- Digester overloaded
- Clogging of diffusers in digester
- Mechanical aerator failure in digester
- Inadequate supernatant removal from sludge lagoons
- Solids accumulation in tank

*Indicates serious problems with the sludge handling process.

Table 10-7

Sludge Handling Process Evaluation (Continued)

Sludge Dewatering Problems

Drying Beds
- Poor sludge distribution on drying beds
- Vegetation in drying beds (unless reed design)
- Dry sludge remaining on drying beds
- Inadequate drying time on drying beds*
- Some unused drying beds
- Dry sludge stacked around drying beds where runoff may enter navigable waters
- Filtrate from sludge drying beds returned to front of plant

Centrifuge
- Excessive solids in fluid phase of sample after centrifugation*
- Inadequate dryness of centrifugal sludge cake*
- Excessive vibration or other mechanical problems

Filter Press
- High level of solids in filtrate from filter presses or vacuum filters*
- Thin filter cake caused by poor dewatering
- Vacuum filter cloth binding
- Low vacuum on filter
- Improperly cleaned vacuum filter media
- Sludge buildup on belts and/or rollers of filter press
- Excessive moisture in belt filter press sludge cake*
- Difficult cake discharge from filter presses
- Filter cake sticks to solids-conveying equipment of filter press
- Frequent media binding of plate filter press
- Sludge blowing out of filter press
- Insufficient run time of sludge dewatering equipment

*Indicates serious problems with the sludge handling process.

Table 10-7

Sludge Handling Process Evaluation (Continued)

Sludge Stabilization Problems

Lagoon
- Objectionable odor from sludge lagoon
- Damage to dikes around sludge drying lagoons
- Unlined sludge lagoons
- Sludge lagoons full, overflowing sludge back to plant or to natural drainage
- Deep rooted vegetation on dikes or berms

Composting
- Piles that give off foul odor
- Inoperable blower
- Temperature does not reach 122-140°F (50-60° C)
- Uncontrolled storm water runoff

Heat Drying/Pelletizing
- Excess moisture in sludge feed
- Insufficient air flow or drying temperature achieved
- Inadequate drying of final product (excess moisture in final product)
- Excess odors associated with treatment area
- Excess odors associated with treated product

Alkaline Stabilization
- Insufficient amount of lime (or other alkaline additive) used to assure pH is raised sufficiently
- Inadequate mixing provided to assure good contact of lime (or other alkaline additive) with sludge solids
- pH problems*
- Excess odors associated with treatment area
- Excess odors associated with treated product
- Excessive lime dust around treatment equipment

Incineration
- Objectionable odors associated with treatment area
- Evidence of excessive dust (ash) around unit
- Visible smoke or dust exhaust from unit
- Lack of compliance with air permit parameters
- Spilling or leaking sludge from dewatered sludge transfer equipment

*Indicates serious problems with the sludge handling process.

Table 10-7

Sludge Handling Process Evaluation
(Continued)

Sludge Disposal Problems

- Sludge constituents not analyzed before disposal
- Sludge not transported in appropriate and approved vehicle
- Surface runoff of sludge at land application site
- Liquid sludge (i.e., less than 10 percent solids) applied to landfill site
- Sludge fails paint filter test
- Inadequate coverage of sludge in subsurface plow injection system
- Objectionable odors generated at land application site*
- Slow drying of soil-sludge mixture in subsurface injection system
- Sludge ponding at land application sites
- Flies breeding, vectors, and/or odors at landfill site
- Inadequate burial of sludge at landfill site
- Excessive erosion at sludge sites
- Sludge disposed of in nonpermitted sites
- Disposal not in accordance with Federal, State, or local regulations
- Sludge lagoons full and overflowing*
- Inadequate runoff control at landfill or land application sites

*Indicates serious problems with the sludge handling process.

Table 10-8

Pollutants Monitored for Land Application, Surface Disposal, and Incineration

Pollutant	Land Application	Surface Disposal (unlined units)	Incineration
Arsenic	✓	✓	✓
Beryllium			✓
Cadmium	✓		✓
Chromium		✓	✓
Copper	✓		
Lead	✓		✓
Mercury	✓		✓
Molybdenum	✓		
Nickel	✓	✓	✓
Selenium	✓		
Zinc	✓		
Nitrogen series	✓		

Organism to Be Monitored	Allowable Level in Sludge
Fecal Coliform[1]	1,000 Most Probable Number (MPN) per gram (Class A) of total solids (dry weight)
Salmonella sp.[1] bacteria (in lieu of fecal coliform)	3 MPN per 4 grams total solids (dry weight)
Enteric Viruses[2]	Less than one plaque-forming unit per 4 grams total solids (dry weight)
Viable Helminth[2] Ova	Less than one viable helminth ovum per 4 grams of total solids (dry weight)
Fecal Coliform[3]	Less than 2×10^6 MPN or less than 2×10^6 colony-forming units per gram of total solids (dry weight) (expressed as geometric mean of the results of 7 individual samples)

[1]All Part 503 Class A Alternatives 1, 2, 3, 4, 5, 6
[2]Class A Alternatives 3 and 4 only
[3]Class B, Alternative 1

10. C. References and Sludge Inspection Checklist

References

I. GENERAL

Clark, J.W., W. Wiessman and M. Hammer, *Water Supply Pollution Control*. (Harper and Row Publishers, 1977).

Code of Federal Regulations. *Standards for the Use or Disposal of Sewage Sludge*. 40 *CFR* Part 503, FR 9387.

Culp, G.L., and N. Folks Heim. January 1978. *Field Manual for Performance Evaluation and Troubleshooting at Municipal Wastewater Treatment Facilities*. U.S. Environmental Protection Agency, EPA 430/9-78-001.

Hinrichs, D.J. *Inspectors Guide for Evaluation of Municipal Wastewater Treatment Plants*. April 1979. U.S. Environmental Protection Agency, 430/9-79-010.

Metcalf and Eddy Inc. *Wastewater Engineering: Treatment Disposal/Reuse*. (McGraw-Hill Book Company, 1979).

Steel, E.W., and T.J. McGhee, *Water Supply and Sewerage*. (McGraw-Hill Book Company, 1979).

U.S. Congress. March 1985. *Overview of Sewage Sludge and Effluent Management*. Office of Technology Assessment, C/R-36b/#10.

U.S. Environmental Protection Agency. January 1975. *Process Design Manual for Suspended Solids Removal*. EPA 625/1-75-0032.

U.S. Environmental Protection Agency. April 1976. *Municipal Sludge Management: EPA Construction Grants Program*. Office of Water Program Operations, EPA 430/9-76/009.

U.S. Environmental Protection Agency. October 1977. *Municipal Sludge Management: Environmental Factors*. Office of Water Program Operations, EPA 430/9-77/004.

U.S. Environmental Protection Agency. 1978. *Operations Manual, Sludge Handling and Conditioning.* Office of Water Program Operations, EPA 430/9-78-002.

U.S. Environmental Protection Agency. September 1979. *Process Design Manual for Sludge Treatment and Disposal*. Municipal Environmental Research Laboratory, EPA 625/1-79-011.

U.S. Environmental Protection Agency. February 1980. *Evaluation of Sludge Management Systems*. Office of Water Program Operations, EPA 430/9-80-001, MCD-61.

U.S. Environmental Protection Agency. September 1984. *Use and Disposal of Municipal Wastewater Sludge*. Intra-Agency Sludge Task Force, EPA 625/10-84-003.

U.S. Environmental Protection Agency. July 1985. *Summary of Environmental Profiles and Hazard Indices for Constituents of Municipal Sludge*. Office of Water Regulations and Standards.

U.S. Environmental Protection Agency. 1987. *Advanced Waste Treatment — Field Study Training Program*.

U.S. Environmental Protection Agency. September 1994. *A Plain English Guide to the EPA Part 503 Biosolids Rule*. EPA 831-B-94-001.

U.S. Environmental Protection Agency. December 1994. *A Guide for Land Appliers on the Requirements of the Fed*eral Standards for the Use or Disposal of Sewage Sludge, 40 *CFR* Part 503. EPA/831-B-93-002b.

U.S. Environmental Protection Agency. September 1995. *A Guide to the Biosolids Risk Assessments for the EPA Part 503 Rule*. EPA 832-B-93-005.

U.S. Environmental Protection Agency. December 1999. *Proposed Rule Revising the Standards for Use and Disposal of Biosolids*. EPA 822-F-99-005.

U.S. Environmental Protection Agency. September 2000. *Biosolids Technology Fact Sheet Alkaline Stabilization of Biosolids*. EPA 832-F-00-052.

U.S. Environmental Protection Agency. September 2000. *Biosolids Technology Fact Sheet Centrifuge Thickening and Dewatering*. EPA 832-F-00-053.

U.S. Environmental Protection Agency. September 2000. *Biosolids Technology Fact Sheet Belt Filter Press*. EPA 832-F-00-057.

II. SAMPLING SLUDGE QUALITY

U.S. Environmental Protection Agency. August 1989. *POTW Sludge Sampling and Analysis Guidance Document*. Office of Water Enforcement and Permits.

U.S. Environmental Protection Agency. August 1988. *Sampling Procedures and Protocols for the National Sewage Sludge Survey*. Office of Water Regulations and Standards.

U.S. Environmental Protection Agency. September 1990. *Analytical Methods for the National Sewage Sludge Survey*. Office of Water Regulations and Standards.

U.S. Environmental Protection Agency. November 1991. *Guidance Manual for NPDES Compliance Inspector: Evaluation of Sludge Treatment Processes*. EPA 833/B-91-100.

U.S. Environmental Protection Agency. November 1991. *Guidance Manual for NPDES Compliance Inspector: Verifying Compliance with Sludge Requirements*.

U.S. Environmental Protection Agency. 1993. Sewage Sludge Sampling Techniques Video.

III. PATHOGENS

U.S. Environmental Protection Agency. July 2003. *Control of Pathogens and Vector Attraction in Sewage Sludge.* Office of Research and Development, EPA 625/R-92/013.

U.S. Environmental Protection Agency. September 1989. *Control of Pathogens in Municipal Wastewater Sludge.* Center for Environmental Research Information, EPA 625/10-89/006.

U.S. Environmental Protection Agency. December 1973. *Pathogen Risk Assessment Feasibility Study.* Office of Research and Development, EPA 670/2-73/098.

IV. LAND APPLICATION

Loeht, R.C. *Pollution Control for Agriculture*. Academic Press Inc., 1984.

National Research Council. July 2002. *Biosolids Applied to Land: Advancing Standards and Practices.*

U.S. Environmental Protection Agency. August 1993. *Preparing Sewage Sludge for Land Application or Surface Disposal; A Guide for Preparers of Sewage Sludge on the Monitoring, Recordkeeping, and Reporting Requirements of the Federal Standards for the Use or Disposal of Sewage Sludge in 40 CFR Part 503.* Office of Water, EPA 831 B-93-002a.

U.S. Environmental Protection Agency. *Land Application of Sewage Sludge; A Guide for Land Appliers on the Recordkeeping and Reporting Requirements of the Federal Standards for the Use and Disposal of Sewage Sludge Management in 40 CFR Part 503.*

U.S. Environmental Protection Agency. October 1983. *Land Application of Municipal Sludge*, Municipal Environmental Research Laboratory, EPA 625/1-83/016.

U.S. Environmental Protection Agency. November 1976. *Application of Sewage Sludge to Cropland; Appraisal of Potential Hazards of the Heavy Metals to Plants and Animals.* Office of Water Program Operations, EPA 430/9-76/013.

U.S. Environmental Protection Agency. June 1978. *Applications of Sludge on Agricultural Land*. Municipal Construction Division, Office of Research and Development, EPA 600/2-78/131b.

U.S. Environmental Protection Agency. June 1978. *Sewage Disposal on Agricultural Soils: Chemical and Microbiological Implications*. Office of Research and Development, EPA 600/2-78/131b.

U.S. Environmental Protection Agency. October 1981. *Land Treatment of Municipal Wastewater*. EPA Center for Environmental Research Information, EPA 625/1-81-013.

U.S. Environmental Protection Agency. September 1993. *A Guide to the Federal EPA Rule for Land Application of Domestic Septage to Non-Public Contact Sites. (Agricultural Land, Forests, and Reclamation Sites) Discussed in Relationship to Existing State Rules and Other Federal Regulations of Septage.* EPA 832-B-92-005.

U.S. Environmental Protection Agency. December 1994. *Land Application of Sewage Sludge: A Guide for Land Appliers on the Requirements of the Federal Standards for the Use and Disposal of Sewage Sludge, 40 CFR Part 503.* EPA 831-B-93-002b.

V. LANDFILLING

U.S. Environmental Protection Agency. May 1994. *Surface Disposal of Sewage Sludge; A Guide for Owners/Operators of Surface Disposal Facilities on the Monitoring, Recordkeeping, and Reporting Requirements of the Federal Standards for the Use and Disposal of Sewage Sludge in 40 CFR Part 503.*

U.S. Environmental Protection Agency. October 1978. *Municipal Sludge Landfills.* Environmental Research Information Center, Office of Solid Waste, EPA 625/1-78/010, SW-705.

VI. DISTRIBUTION AND MARKETING

U.S. Environmental Protection Agency. August 1985. *Composting of Municipal Wastewater Sludges.* EPA Center for Environmental Research Information, EPA 625/4-85-014.

U.S. Environmental Protection Agency. June 1981. *Composting Processes to Stabilize and Disinfect Municipal Sewage Sludge.* Office of Water Program Operations, EPA 430/9-81-011, MCD-79.

VII. INCINERATION

U.S. Environmental Protection Agency. September 1985. *Municipal Wastewater Sludge Combustion Technology.* EPA Center for Environmental Research Information, EPA 625/4-85-015.

VIII. MISCELLANEOUS

U.S. Environmental Protection Agency. September 1987. *Dewatering Municipal Wastewater Sludges*, Office of Research and Development. EPA 625/1-87/014.

U.S. Environmental Protection Agency. December 1973. *Odors Emitted From Raw and Digested Sewage Sludge.* Office of Research and Development, EPA 670/2-73/098.

U.S. Environmental Protection Agency. October 1982. *Process Design Manual for Dewatering Municipal Wastewater Sludges.* Office of Research and Development, EPA 625/1-82-014.

U.S. Environmental Protection Agency. April 1986. *Radioactivity of Municipal Sludge.* Office of Water Regulations and Standards.

U.S. Environmental Protection Agency. Most recent *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods.* EPA SW-846.

U.S. Environmental Protection Agency. 1990. *NPDES Compliance Monitoring Inspector Training Module on Laboratory Analysis*.

U.S. Environmental Protection Agency. July 2000. *Guide to Field Storage of Biosolids*. EPA 832-B-00-007

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SLUDGE INSPECTION CHECKLIST

A. PERMIT VERIFICATION

Yes No N/A	1.	Are 40 *CFR* Part 503 sludge use and disposal requirements contained in a current NPDES permit, in a separate "sludge only" NPDES permit, in a RCRA Subtitle C permit, or in a CAA permit? [503.3(a)(1) or (2)] (1)
	2.	Sludge use and disposal practice(s):
Yes No N/A		a. Land Application ____ [503.10]
		Bulk Sewage Sludge ____ [503.11(e)]
		Bulk Material Derived from Sewage Sludge ____ [503.11(e)]
		Or
		Sold or Given Away in a Bag or Other Container ____ [503.11(e)]
Yes No N/A		b. Surface Disposal ____ [503.20]
Yes No N/A		c. Sewage Sludge Incineration ____ [503.40]
Yes No N/A		d. Onsite or Offsite Storage ____ [503.9(y)]
		Date storage began ____ ended ____
		(Maximum time allowed: 2 years from February 19, 1993)
Yes No N/A		e. Other (list)_____
Yes No N/A	3.	Each sludge use or disposal practice is permitted? [503.3(a)(1)] (1)
Yes No N/A	4.	Notification is given to EPA/State of new or different sludge disposal method? [Permit]
Yes No N/A	5.	Number and location of disposal sites/activities are as described in the permit or fact sheet or land application plan (40 *CFR* Part 501)? [Permit]
Comments:		

SLUDGE INSPECTION CHECKLIST (Continued)

B. RECORDKEEPING AND REPORTING EVALUATION

Yes No N/A	1.	Self-monitoring data are available for all regulated pollutants? [503.17], [503.27], [503.43]
Yes No N/A	2.	Pathogen and vector attraction reduction method description and certification statement available? [503.17], [503.27]
Yes No N/A	3.	Records are available for all use or disposal practices? [503.17], [503.27], [503.47]
Yes No N/A	4.	Accurate records of sludge volume or mass are maintained, when appropriate? [503.25], [503.47]
Yes No N/A	5.	Monitoring and analyses are performed more often than required by permit? If so, results are reported in the permittee's self-monitoring report? [Permit]
Yes No N/A	6.	Unit operations records verify compliance with pathogen and vector attraction reduction requirements, when appropriate? [503.15], [503.25]
Yes No N/A	7.	Self-monitoring is conducted at the frequency specified in the permit, in 503.16 Table 1 (land application), or in 503.26 Table 1 (surface disposal)? [503.16], [503.26] or [503.46 Table 1 (incineration)] (Production dependent 0-289 mtpy: 1/yr., 290-1499 mtpy: 1/qtr., 1500-14999 mtpy: ½ mo., 15000 mtpy and greater, 1/mo.) mtpy-metric ton per year
Yes No N/A	8.	Facility reports sludge monitoring data at the frequency specified in the permit? (Only for Class I facilities, total design flow >1 mgd, or serving >10,000 people) [503.18], [503.28], [503.48]
Yes No N/A	9.	Sludge records are maintained for at least 5 years? [503.17], [503.27], [503.47]
Yes No N/A	10.	Sludge data are reported on Discharge Monitoring Report (DMR) or approved form? [Permit]
Yes No N/A	11.	Sludge records are adequate to assess compliance with annual and/or cumulative pollutant loading rates or other established permit limits? [503.13(a) (2) (i)], [503.13(a) (4) (ii)]
Comments:		

SLUDGE INSPECTION CHECKLIST (Continued)

C. SLUDGE SAMPLING AND ANALYSIS EVALUATION

Yes No N/A	1.	Sludge samples are taken at locations specified in the permit? [Permit]
Yes No N/A	2.	Sludge sample locations are appropriate for obtaining representative samples? [503.8(a)]
Yes No N/A	3.	Sampling and analysis are conducted for parameters specified in the permit or in 40 *CFR* Part 503? [Permit], [503.13], [503.23], [503.46]
	4.	Sample collection procedures
Yes No N/A		a. Adequate sample volumes are obtained?
Yes No N/A		b. Proper preservation techniques are used?
Yes No N/A		c. Containers conform to appropriate analytical method specified in 40 *CFR* 503.8?
Yes No N/A		d. Samples analyzed in the appropriate time frames in accordance with 40 *CFR* 503.8?
Yes No N/A	5.	Are results reported on a dry weight basis? [503.13], [503.23], [503.43] (Dry weight concentration = Wet weight concentration/Decimal fraction of solids) e.g. A sludge containing 20 mg/l Cu and having 5% solids. Dry weight Cu (mg/kg) = $\frac{20 \text{ mg/1}}{0.05}$ = 400 mg/kg
Yes No N/A	6.	Sample is refrigerated subsequent to compositing?
Yes No N/A	7.	Chain-of-custody procedures are employed?
Yes No N/A	8.	Analytical methods used are approved methods of 40 *CFR* 503.8?
Comments:		

SLUDGE INSPECTION CHECKLIST (Continued)

D. UNIT PROCESSES

General Sludge Processes

Yes No N/A	1.	Sludge process control parameters maintained as appropriate?
Yes No N/A	2.	Adequate equipment redundancy (e.g., back-up units)?
Yes No N/A	3.	Adequate sludge storage capacity?
Yes No N/A	4.	Contingency plan for sludge disposal practice?
Yes No N/A	5.	Solids handling operation adequate to manage volume of sludge?
Comments:		

Drying Beds, Gravity Thickener, Centrifuge, and Dissolved Air Floatation

Yes No N/A	1.	Is primary unstabilized sludge fed to the thickener, centrifuge or drying bed? If yes, list percentage of unstabilized sludge _____.
Yes No N/A	2.	What is the average % solids of the sludge before thickening, drying or centrifuging? _____ % after? _____ %
Yes No N/A	3.	Is sludge mixed with other materials before or after thickening?
Yes No N/A	4.	For sludge containing unstabilized solids, is the percent solids greater than 90% prior to mixing with other materials?
Yes No N/A	5.	For sludge containing no unstabilized solids, is the percent solids greater than 75% prior to mixing with other materials?
Comments:		

SLUDGE INSPECTION CHECKLIST (Continued)

D. UNIT PROCESSES (Continued)

Anaerobic Digestion

	1.	Sludge fed to digester(s) includes: ___Primary ___Secondary ___Combined
	2.	Digester(s) operating mode: ___high rate ___ low rate
Yes No N/A	3.	Digester(s) are operated at proper temperature [mesophilic: 95°F (35°C) and thermophilic: 131°F (55°C)? List operating mode: ___ mesophilic ___ thermophilic
Yes No N/A	4.	Temperature monitoring location and frequency sufficient to demonstrate compliance with Class B pathogen reduction requirements for PSRP? Average Temperature: ____°C or °F
Yes No N/A	5.	Solids Retention Time (SRT) or Mean Cell Residence time (MCRT) calculated properly?*
Yes No N/A	6.	SRT or MCRT sufficient to demonstrate compliance with Class B pathogen reduction requirements for PSRP? Average SRT or MCRT: ____days *For batch operated digesters with no recycle: SRT or MCRT = Mass of solids in digester, kg / Solids removed, kg/day This formula can be used to estimate SRT or MCRT for all digester systems. For calculating SRT or MCRT for other system configurations, use the WEF Manual of Practice or other references. Always write down the calculation used by the facility no matter what the configuration is.
Comments:		

SLUDGE INSPECTION CHECKLIST (Continued)

D. UNIT PROCESSES (Continued)

Aerobic Digestion

		1. Sludge fed to digester(s) includes: ___Primary ___Secondary ___Combined
		2. Digester(s) operating mode: ___high rate ___ low rate
Yes No N/A		3. Digester(s) are operated at proper temperature [cryophilic: <50°F (<10°C), mesophilic: 50-108°F (10-42°C), and thermophilic: >108°F (42°C)]? List operating mode: ___ cryophilic ___ mesophilic ___ thermophilic
Yes No N/A		4. Temperature monitoring location and frequency sufficient to demonstrate compliance with Class B pathogen reduction requirements for PSRP or with Class A pathogen reduction requirements for PFRP (Thermophilic aerobic digestion only)? Average Temperature: ____°C or °F
Yes No N/A		5. Solids Retention Time (SRT) or Mean Cell Residence time (MCRT) calculated properly?*
Yes No N/A		6. SRT or MCRT sufficient to demonstrate compliance with Class B pathogen reduction requirements for PSRP or with Class A pathogen reduction requirements for PFRP (Thermophilic digestion only)? Average SRT or MCRT: ____days
Yes No N/A		7. Aerobic conditions verified through dissolved oxygen monitoring? *For batch operated digesters with no recycle: SRT or MCRT = Mass of solids in digester, kg / Solids removed, kg/day This formula can be used to estimate SRT or MCRT for all digester systems. For calculating SRT or MCRT for other system configurations, use the WEF Manual of Practice or other references. Always write down the calculation used by the facility no matter what the configuration is.
Comments:		

SLUDGE INSPECTION CHECKLIST (Continued)

D. UNIT PROCESSES (Continued)

Composting

		1. Type of composting performed: ____ In vessel ____ Static piles ____ Windrows
		2. Type of sludge composted: ____ Primary ____ Secondary ____ Combined
Yes No N/A		3. Is the moisture content monitored?
Yes No N/A		4. Is compost mixed? Method? _____ Frequency of turnings? _____
Yes No N/A		5. Is oxygen content monitored?
Yes No N/A		6. Is temperature monitored?
Yes No N/A		7. Are total and total volatile solids monitored?
		8. Active phase ____ days Curing phase ____ days
Yes No N/A		9. Is site runoff treated? Where? _____
Yes No N/A		10. Temperature monitoring location and frequency sufficient to demonstrate compliance with Class B pathogen reduction requirements for PSRP or with Class A pathogen reduction requirements for PFRP?
Yes No N/A		11. Temperature and/or oxygen monitoring sufficient to determine compliance with vector attraction reduction requirements?
Comments:		

SLUDGE INSPECTION CHECKLIST (Continued)

E. LAND APPLICATION OF SEWAGE SLUDGE

Yes No N/A	1.	Sewage sludge or material derived from sewage sludge is land applied to: Agricultural Land _____ Forest _____ Reclamation Site _____ Lawn or Home Garden _____ Public Contact Site (park, etc.) _____
Yes No N/A	2.	Do monitoring results show pollutant concentrations below values shown in 40 *CFR* 503.13(b)(1) Table 1? [503.13(a)(1)] (2)
Yes No N/A	3.	Do monitoring results show pollutant concentrations below values shown in 40 *CFR* 503.13(b)(3)? (3)
	4.	Classifications of Sewage Sludge with respect to Pathogens: [503.30] (4) Class A _____ Class B _____ Unknown _____
Yes No N/A	5.	Are Class A Pathogen reductions requirements met? [503.15(a)] (4)
	6.	Indicate which method is used to meet Class A requirements: [503.32(a)] ___ Fecal Coliform <1000 MPN/g total solids, or Salmonella <3 MPN/4 g total solids, and Time/Temperature requirements. [503.32(a)(3)] ___ Fecal Coliform <1000 MPN/g total solids, or Salmonella <3 MPN/4 g total solids, and pH requirements. [503.32(a)(4)] ___ Fecal Coliform <1000 MPN/g total solids, or Salmonella <3 MPN/4 g total solids, and enteric viruses or helminth ova reduction requirements. [503.32(a)(5)] ___ Fecal Coliform <1000 MPN/g total solids, or Salmonella <3 MPN/4 g total solids, and enteric viruses or helminth ova density requirements. [503.32(a)(6)] ___ Fecal Coliform <1000 MPN/g total solids, or Salmonella <3 MPN/4 g total solids, and Process to Further Reduce Pathogens (PFRP). [503.32(a)(7)] and [503 Appendix B] (5) ___ Fecal Coliform <1000 MPN/g total solids, or Salmonella <3 MPN/4 g total solids, and equivalent PFRP. [503.32(a)(8)] and [503 Appendix B] (5)
Yes No N/A	7.	Are Class B Pathogen reduction requirements met? [503.32(b)] (4)
	8.	Indicate which method(s) is used to meet Class B requirements: ___ Geometric mean of seven Fecal Coliform samples with <2,000,000 MPN/g total solids or <2,000,000 Colony Forming Units/g total solids. [503.32(b)(2)] ___ Treated by Process to Significantly Reduce Pathogens (PSRP). [503.32(b)(3)] and [503 Appendix B] (5) Treated by equivalent PSRP. [503.32(b)(4)] and [503 Appendix B] (5)

SLUDGE INSPECTION CHECKLIST (Continued)

E. LAND APPLICATION OF SEWAGE SLUDGE (Continued)

Yes No N/A	9. For Class B sludge which is land applied, are Site Restrictions practiced? [503.32 (b)(5)] [4]
Yes No N/A	10. Indicate Site Restrictions practiced where applicable: ___ Food crops (above ground) are harvested >14 months after application of sewage sludge? [503.32(b)(5)(i)] ___ Food Crops (below ground) are harvested >20 months after application of sewage sludge when sludge stays on land for >4 months prior to incorporation into soil? [503.32(b)(5)(ii)] ___ Food Crops (below ground) are harvested >38 months after application of sewage sludge when sludge stays on land for <4 months prior to incorporation into soil? [503.32(b)(5)(iii) ___ Food Crops, feed crops, and fiber crops are harvested >30 days after application of sewage sludge? [503.32(b)(5)(iv)] ___ Animal grazing allowed on land only >30 days after application of sewage sludge? [503.32(b)(5)(v)] ___ Turf grown on land where sewage sludge was applied placed on high public expose land or lawn is harvested >1 year after application of sewage sludge? [503.32(b)(5)(vi)] ___ Public access is restricted to land with a potential for high public exposure for 1 year? [503.32(b)(5)(vii)] ___ Public access is restricted to land with a potential for low public exposure for 30 days? [503.32(b)(5)(viii)]
Yes No N/A	11. Is a Vector Attraction Reduction method practiced? [503.15(c)] [6]
Yes No N/A	12. Indicate Vector Attraction Reduction method: [503.33(b)] ___ 38% Volatile Solids Reduction. [503.33(b)(1)] [7] ___ 40 day test - Volatile Solids reduced <17%. [503.33(b)(2)] (Anaerobic Digestion Only) ___ 30 day test - Volatile Solids reduced <15%. [503.33(b)(3)] (Aerobic Digestion Only) ___ Specific Oxygen Uptake Rate (SOUR) <1.5 mg/hr/gm TS @ 20°C. [503.33(b)(4)] ___ Aerobic Process for >14 days @ >40°C with average sludge temperatures >45°C. [503.33(b)(5)] ___ pH >12 for 2 hours and pH >11.5 for 22 hours [503.33(b)(6)] ___ Sludge (with no unstabilized solids) contains >75% Total Solids prior to mixing with other materials. [503.33(b)(7)] ___ Sludge (contains unstabilized solids) contains >90% Total Solids prior to mixing with other materials. [503.33(b)(8)]

SLUDGE INSPECTION CHECKLIST (Continued)

E. LAND APPLICATION OF SEWAGE SLUDGE (Continued)

	___ Subsurface Injection. [503.33(b)(9)] ___ Soil Incorporation. [503.33(b)(10)]
Yes No N/A	13. Are general requirements (503.12) and management practices (503.14) applied for sludge not meeting Table 3 pollutant concentrations, Class pathogen reduction requirements, and vector attraction reduction methods? [503.10], [503.12], [503.14]
Yes No N/A	14. Indicate management practices where applicable: ___ No threatened or endangered species present or critical habitat affected at the location(s) where bulk sludge is applied. ___ Bulk sludge not applied to frozen or snow covered ground. ___ Bulk sludge applied >10 meters from waters of the U.S. ___ Bulk sludge applied at a rate equal to or less than agronomic rate. ___ Label affixed on bag or information sheet provided to user of sold and given away sludge indicating name of sludge preparer, application instructions, and maximum annual whole sludge application rate.
Yes No N/A	15. Indicate general requirements practiced where applicable: ___ Sludge is not applied to a site where the cumulative pollutant loading or annual application rate has been reached. ___ Notification given to the sludge applier regarding total nitrogen content of the sludge. ___ Sufficient information required to comply with 40 *CFR* Part 503 is given to preparers/appliers/land owners. ___ Written notification given to permitting authority (including States) regarding the location of land application sites, appropriate NPDES permit numbers.
Yes No N/A	16. Description of how management practices are met for each land application site available?
Comments:	

SLUDGE INSPECTION CHECKLIST (Continued)

Land Application Footnotes

(1) Permits are not required. Part 503 is self-implementing. Part 503 does not cover industrial sludges or grit and screenings.

(2) 503.13(b)(1), Table 1 values must be met to land apply sludge:

Table 1 (mg/kg)

Arsenic	75	Lead	840	Nickel	420
Cadmium	85	Mercury	57	Selenium	100
Copper	4300	Molybdenum	75	Zinc	7500

(3) 503.13(b)(3), Table 3 must be met for any sludge applied to a lawn or home garden. For bulk sludge, Table 3 must be met or the sludge is subject to cumulative loading limits in 503.13(b)(2). For sewage sludge sold and given away in a bag or other container, Table 3 must also be met or the sludge is subject to annual pollutant loadings in 503.13(b)(4). This also signals that additional recordkeeping requirements of 503.12 and 503.17 apply.

Table 3 (mg/kg)

Arsenic	41	Lead	300	Selenium	100
Cadmium	39	Mercury	17	Zinc	2800
Copper	1500	Nickel	420		

(4) Class A requirements must be met when bulk sludge is land applied to a lawn or home garden, or when sewage sludge is sold or given away in a bag or other container. Also, Class A requirements or Class B requirements combined with appropriate site restrictions must be met for when bulk or bulk material derived from sludge is applied to agricultural land, reclamation site, forest, or public contact site.

(5) Process to Significantly Reduce Pathogens (PSRP) includes Aerobic Digestion, Air Drying, Anaerobic Digestion, Composting, and Lime Stabilization. Process to Further Reduce Pathogens (PFRP) includes Composting, Heat Drying, Heat Treatment, Thermophilic Aerobic Digestion, Beta Ray Irradiation, Gamma Ray Irradiation, and Pasteurization. Each process has required operating conditions to demonstrate compliance. See 503 Appendix B and Unit Process Checklists.

(6) One of the methods 503.33(b)(1)-(10) must be used when land applying bulk sewage sludge to agricultural land, forest, a public contact site, or a reclamation site. One of the methods 503.33(b)(1)-(8) must be met when land applying bulk sludge to a lawn or home garden, or when sewage sludge or derived material is sold or given away in a bag or other container.

(7) Volatile solids reduction through the sludge treatment train [only] is generally calculated using the Van Kleek equation: :

Other Variations of this formula are presented in the document Environmental Regulations and Technology-Control of Pathogens and Vector Attraction in Sewage Sludge, EPA-625/R-92/013. See document for specific calculations. Website: http://www.epa.gov/ORD/NRMRL/Pubs/1992/625R92013.html

SLUDGE INSPECTION CHECKLIST (Continued)

F. SURFACE DISPOSAL

Yes No N/A	1. Does each Surface Disposal Unit (SDU) have a liner and leachate collection system?
	2. Smallest distance from active SDU boundary to property boundary is _____ ft.
Yes No N/A	3. For an active SDU (property boundary is greater that 150 meters from SDU) and without a liner or leachate collection system, do monitoring results show pollutant concentrations below values shown in 40 *CFR* 503.23(a)(1) Table 1? [503.23(a)(1)][(1)]
Yes No N/A	4. For an active SDU without a liner and leachate collection system (property boundary is less than 150 meters from SDU), do monitoring results show pollutant concentrations below values shown in 40 *CFR* 503.23(a)(2) Table 2? [503.23(a)(1)][(2)]
Yes No N/A	5. Are management practices employed? [503.24]
Yes No N/A	6. List management practices where applicable: ___ No threatened or endangered species present or critical habitat affected at the location where bulk sludge is surface disposed. ___ Surface disposal unit shall not restrict flow of base flood. ___ If in seismic impact zone, design will withstand recorded horizontal ground acceleration. ___ Located > 60 meters from any fault displaced in Holocene time. ___ Not located in unstable area or wetlands. ___ Runoff collection and treatment with 25-year 24-hour storm runoff event storage capacity. ___ Leachate collection system operated and maintained for 3 years after closure of the surface disposal unit. ___ Leachate treated and disposed of in accordance with applicable requirements, i.e., NPDES permit. ___ Methane is contained under covered units at a concentration less than 25% of the LEL for methane. ___ Methane is contained under a final cover placed on a closed unit maintained at a concentration less than 25% of the LEL for methane for three years after closure. ___ Methane concentration at the property line is maintained at a concentration less than the LEL for methane for three years after closure of the unit. ___ No feed or food crops grown on active unit. [(3)] ___ No animal grazing allowed on active unit. [(3)]

SLUDGE INSPECTION CHECKLIST (Continued)

F. SURFACE DISPOSAL (Continued)

	___ Public access restricted for the period of time while a unit is active and for three years after last active unit in a site closes. ___ Sludge placed in an active unit does not contaminate groundwater aquifers. (4)
Yes No N/A	7. Classification of Sewage Sludge with respect to Pathogens: [503.30] Class A _____ Class B _____ Unknown _____
Yes No N/A	8. Are Class A Pathogen reductions requirements met? [503.15(a)] (5)
	9. Indicate which method is used to meet Class A requirements: [503.32(a)] ___ Fecal Coliform <1000 MPN/g total solids, or Salmonella <3 MPN/4 g total solids, and Time/Temperature requirements. [503.32(a)(3)] ___ Fecal Coliform <1000 MPN/g total solids, or Salmonella <3 MPN/4 g total solids, and pH requirements. [503.32(a)(4)] ___ Fecal Coliform <1000 MPN/g total solids, or Salmonella <3 MPN/4 g total solids, and enteric viruses or helminth ova reduction requirements. [503.32(a)(5)] ___ Fecal Coliform <1000 MPN/g total solids, or Salmonella <3 MPN/4 g total solids, and enteric viruses or helminth ova density requirements. [503.32(a)(6)] ___ Fecal Coliform <1000 MPN/g total solids, or Salmonella <3 MPN/4 g total solids, and Process to Further Reduce Pathogens (PFRP). [503.32(a)(7)] and [503 Appendix B] ___ Fecal Coliform <1000 MPN/g total solids, or Salmonella <3 MPN/4 g total solids, and equivalent PFRP. [503.32(a)(8)] and [503 Appendix B] (7)
Yes No N/A	10. Are Class B Pathogen reduction requirements met? [503.32(b)] (5)
	11. Indicate which method(s) is used to meet Class B requirements: ___ Geometric mean of seven Fecal Coliform samples with <2,000,000 MPN/g total solids or <2,000,000 Colony Forming Units/g total solids. [503.32(b)(2)] ___ Treated by Process to Significantly Reduce Pathogens (PSRP). [503.32(b)(3)] and [503 Appendix B] (6) ___ Treated by equivalent PSRP. [503.32(b)(4)] and [503 Appendix B] (6)
Yes No N/A	12. Is a Vector Attraction Reduction method practiced? [503.25(b)] (7)
Yes No N/A	13. Indicate Vector Attraction Reduction method: [503.33(b)] ___ 38% Volatile Solids Reduction. [503.33(b)(1)] ___ 40 day test - Volatile Solids reduced <17%. [503.33(b)(2)] (Anaerobic Digestion Only)

SLUDGE INSPECTION CHECKLIST (Continued)

F. SURFACE DISPOSAL (Continued)

		___ 30 day test - Volatile Solids reduced <15%. [503.33(b)(3)] (Aerobic Digestion Only) ___ Specific Oxygen Uptake Rate (SOUR) <1.5 mg/hr/gm TS @ 20°C. [503.33(b)(4)] ___ Aerobic Process for >14 days @ >40°C with average sludge temperatures >45°C. [503.33(b)(5)] ___ pH >12 for 2 hours and pH >11.5 for 22 hours [503.33(b)(6)] ___ Sludge (with no unstabilized solids) contains >75% Total Solids prior to mixing with other materials. [503.33(b)(7)]
		___ Sludge (contains unstabilized solids) contains >90% Total Solids prior to mixing with other materials. [503.33(b)(8)]
		___ Subsurface Injection. [503.33(b)(9)] ___ Soil Incorporation. [503.33(b)(10)] ___ Sludge covered with soil or other material at the end of the day. [503.33(b)(11)]
Yes No N/A		14. Have any SDUs been closed?
Yes No N/A		15. Has facility submitted closure and post closure plan for any active SDU 180 days prior to closing? [503.22(c)]
Comments:		

SLUDGE INSPECTION CHECKLIST (Continued)

Surface Disposal Footnotes

(1) Table 1 of 503.23(a)(1) must be met for all sludge placed in an active surface disposal unit with a distance of greater than 150 meters from the boundary of the surface disposal unit to the property line. Site-specific limits can also be set by the permitting authority in accordance with 503.23(b).

Table 1 (mg/kg - dry weight basis)

Arsenic	73	Chromium	600	Nickel	420

(2) Table 2 of 503.23(a)(2) must be met for all sludge placed in an active surface disposal unit with a distance of less than 150 meters from the boundary of the surface disposal unit to the property line. Site-specific limits can also be set by the permitting authority in accordance with 503.23(b).

Table 2 (mg/kg - dry weight basis)

Distance between unit boundary and property line (m)	Pollutant Concentration (mg/kg)		
	Arsenic	Chromium	Nickel
0 to less than 25	30	200	210
25 to less than 50	34	220	240
50 to less than 75	39	260	270
75 to less than 100	46	300	320
100 to less than 125	53	360	390
125 to less than 150	62	450	420

(3) Unless specific approval from the permitting authority has been obtained by the facility.

(4) Facility must have results of groundwater monitoring study developed by a qualified groundwater scientist or a certification from a qualified groundwater scientist to demonstrate no contamination.

(5) Facility must meet Class A pathogen reduction requirements of 503.32(a) or Class B 503.32(b)(2) through (b)(4) unless vector attraction reduction method 503.33(b)(11), covering sludge at the end of the day, is used.

(6) Process to Significantly Reduce Pathogens (PSRP) includes Aerobic Digestion, Air Drying, Anaerobic Digestion, Composting, and Lime Stabilization. Process to Further Reduce Pathogens (PFRP) includes Composting, Heat Drying, Heat Treatment, Thermophilic Aerobic Digestion, Beta Ray Irradiation, Gamma Ray Irradiation, and Pasteurization. Each process has required operating conditions to demonstrate compliance. See 503 Appendix B and Unit Process Checklist.

(7) Facility must meet vector attraction reduction requirements of 503.33(b) to surface dispose sludge.

SLUDGE INSPECTION CHECKLIST (Continued)

G. SEWAGE SLUDGE INCINERATION

Yes No N/A	1. Does the incinerator meet the definition of a sewage sludge incinerator?
Yes No N/A	2. Do sewage sludge monitoring results show pollutant concentrations below permit limits?
Yes No N/A	3. Does THC monitoring show concentrations below 100 ppm (monthly average)?
Yes No N/A	4. Are there instruments installed that continuously measure and record THC (or alternatively CO), oxygen concentration, moisture content, and combustion temperatures?
Yes No N/A	5. Is the THC instrument calibrated as required by 503.45 (once every 24-hour period using propane) or the permit?
Yes No N/A	6. Are the other instruments calibrated as required by the permit?
Yes No N/A	7. Are the instruments operated and maintained as specified by the permit?
Yes No N/A	8. How many times was the incinerator operated at above the maximum combustion temperature specified in the permit? _____ For how long was the incinerator in operation above the maximum combustion temperature? _____
Yes No N/A	9. How many times was the incinerator operated outside the range of the air pollution control devices operating parameters specified in the permit? _____ For how long was the incinerator in operation outside the ranges? _____
Yes No N/A	10. Are the following records maintained:
Yes No N/A	Concentration of lead, arsenic, cadmium, chromium, and nickel in the sewage sludge fed to the sewage sludge incinerator.
Yes No N/A	THC concentrations in the exit gas.
Yes No N/A	Information that indicates NESHAP for beryllium in Subpart C of 40 *CFR* Part 61 are met.
Yes No N/A	Information that indicates NESHAP for mercury in Subpart E of 40 *CFR* Part 61 are met.
Yes No N/A	Combustion temperatures, including maximum combustion temperature.
Yes No N/A	Values for air pollution control device operating parameters.
Yes No N/A	Oxygen concentration.
Yes No N/A	Information used to measure moisture content in the exit gas.
Yes No N/A	Sewage sludge feed rate.

SLUDGE INSPECTION CHECKLIST (Continued)

G. SEWAGE SLUDGE INCINERATION (Continued)

Yes No N/A	Stack height of incinerator.
Yes No N/A	Dispersion factor for the site.
Yes No N/A	Control efficiency for lead, arsenic, cadmium, chromium, and nickel.
Yes No N/A	Risk specific concentration for chromium (if applicable).
Yes No N/A	Calibration and maintenance log for the instruments used to measure THC (or CO), oxygen concentration, moisture content, and combustion temperatures.
Yes No N/A	Are these records maintained for 5 years?
Yes No N/A	11. Have all instances of noncompliance been reported as specified by the permit?
Comments:	

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